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TECHNOLOGY ASSESSMENT OF FUTURE INTERCITY PASSENGER TRANSPORTATION SYSTEMS

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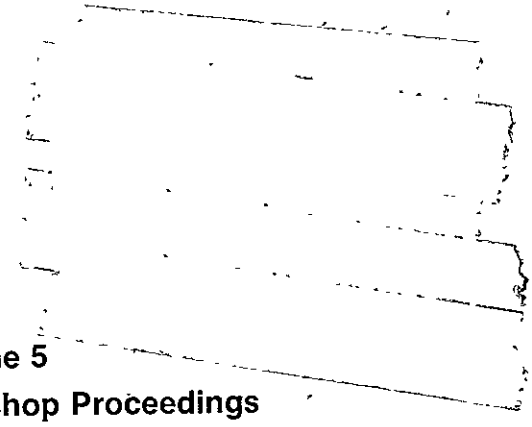

Volume 5
Workshop Proceedings

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A management group for the project consists of representatives of:

NASA, Ames Research Center

NASA, Office of Aeronautics and Space Technology, Headquarters

DOT, Office of the Assistant Secretary for Systems Development and Technology

DOT, Transportation Systems Center

The views and conclusions presented in this report are those of the staff of the Technology Assessment Team and do not necessarily reflect those of NASA or DOT.

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I. INTRODUCTION

A technology assessment of intercity transportation systems was undertaken jointly by NASA and DOT. It was intended that the study assess technical, economic, environmental, and sociopolitical issues associated with future intercity transportation system options.

> "A goal of the technology assessment is to assess the impacts of new transportation technologies on society and to identify potential problems, drawbacks, and advantages of individual technologies.
>
> A second goal is to identify research and analysis tasks to alleviate negative impacts, to augment positive impacts or to better understand these potential impacts. We hope to develop valuable insights to societal benefits or problems produced by the potential introductions of the technologies, and to develop recommendations for research and technology efforts toward improving the impacts."*

The emphasis was on domestic passenger transportation, but interfaces with freight and international transportation were considered.

A key feature of the project was a one-week Workshop at the midpoint of the study to review intermediate results and to identify and debate issues and impacts related to future transportation alternatives. This volume documents the proceedings.

The Workshop was attended by forty invited "study participants" and members of the government/industry/university project team (see Appendix A). Hershey, Pennsylvania, was the site of the Workshop during the week of September 7, 1975. A schedule of the week's activities is given in Figure I-1.

The Workshop was conducted primarily in small working groups termed "assigned panels." There were four such panels; they met several times during the week and were asked to follow parallel lines of inquiry. Chapter III of this volume contains the chairmen's reports of these assigned panels.

Time was also allotted at the Workshop for "special topic sessions." Potential topics were suggested by study participants, and sign-up sheets were posted to gauge interest in holding a session. In each case where sufficient interest developed, two or three hours were devoted

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*NASA/DOT Management Group for the project.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
	9-12 a.m. Plenary Session - Study Progress - Workshop Objectives	9-12 a.m. Assigned Panels - Session 2	9-12 a.m. Assigned Panels - Session 3	9-12 a.m. Assigned Panels - Session 5	9-12 a.m. Plenary Session - Panel Reports
	12 Noon Host Lunch Speaker: William Stoney				12 Noon Host Lunch
2 p.m. Registration	2-5 p.m. Assigned Panels - Session 1	2-5 p.m. Special Topic Sessions	2-5 p.m. Assigned Panels - Session 4	2-5 p.m. Special Topic Sessions	
7-9 p.m. Plenary Session - Welcome and Reception Speaker: Alan Lovelace	8-10 p.m. Special Topic Sessions	8-10 p.m. Plenary Session - Panel Reports	8-10 p.m. Special Topic Sessions	6-9 p.m. Reception and Dinner Speaker: John Barnum	

Figure I-1. WORKSHOP ACTIVITIES, SEPTEMBER 7 TO 12, 1975

to a small group discussion of the topic. Reports of the special topic sessions are presented in Chapter IV of this volume.

Speakers from DOT and NASA addressed plenary sessions of the Workshop. Their remarks are summarized in Chapter V.

II. SUMMARY OF MAJOR THEMES

Introduction

By design, the Workshop was relatively unstructured to allow for a wide-ranging debate of intercity transportation issues and impacts. The participants represented a diverse range of background interests and the study they addressed has a very broad scope. Thus, it is not surprising that the panel reports cover an extremely wide range of topics in relatively limited depth. Coupled with this diversity of topics are significant differences in the approaches taken in the various assigned panel and special topic sessions.

One panel (Panel 2) emphasized a quantitative approach to develop data on how future conditions might impact on the likelihood of implementing selected technologies. The other panels generally focused on impacts that selected future transportation innovations might have on society, but tended to express their results in terms of forecasts of (uncertain) future conditions and related prospects on the roles for intercity transportation modes.

In spite of their wide-ranging nature, the discussions did identify some major and important themes. This section describes these major themes, as drawn from the reports of panel chairmen.

Capital May Be Scarce

A dominant issue at the Workshop relates to the availability of funds for future intercity transportation system development. Many participants anticipate that capital--both public and private--will be scarce. Further, much of that which is available will be devoted to such needs as the development of energy resources. Capital scarcity was seen to be a particularly formidable impediment to the introduction of new large-scale technologies but concerns are also noted on the availability of funds for maintenance and incremental improvement of existing intercity systems.

In spite of these possibilities, there is need to continue transportation research and technology development activities. Institutional arrangements and funding mechanisms are needed to enable long-range technology explorations so that new systems are ready for implementation when conditions are more favorable.

Automobiles Will Continue as a Dominant Intercity Mode

Considerable attention was directed to the future of the private automobile. It was almost unanimously felt that the mobility and privacy provided by autos could maintain the mode as a principal means of intercity travel. In response to high energy costs, a continuing and perhaps accelerating trend toward smaller, lighter vehicles with improved technology and much reduced fuel consumption appears clear. Coupled to this trend are uncertainties on future new car prices and sales levels--improved autos may be expensive, leading to greater emphasis on long-lived vehicles. Panel reports describe a number of potential impacts on the auto industry that could result from these conditions, including impacts on manufacturers (retooling), suppliers (new lightweight materials), and labor. There are also safety considerations related to small autos operating in the proximity of trucks and buses.

Intercity Bus Service Is Attractive

Numerous positive impacts were cited for intercity buses. Energy efficiency is high, and the mode is capable of providing mobility to most segments of society--particularly the less-affluent. The incremental and flexible nature of bus service also makes it adaptable to a variety of possible future settings. Currently, there is need for better integration of bus services with those of other intercity (and urban) modes. More attractive and better located terminals are viewed as a means of gaining broader public acceptance of bus travel. Wider vehicles might also increase the appeal of bus service, but regulatory and political barriers to this change (and/or safety concerns) are noted. Beyond these service, equipment, and facilities improvements, there may be more basic social reasons why travelers tend not to use intercity buses.

Incremental Improvement to Air Service

Conventional aircraft service is anticipated to retain its role as the dominant public mode for longer distance intercity travel. There may be less first-class service and more charter flights as the percentage of nonbusiness travelers increases. Some participants believe that less economic regulation might lead to fewer but more profitable carriers; others disagree.

The infrastructure for air service is viewed as already in place to a large extent. Incremental improvements to aircraft are foreseen as a continuation of existing trends although sources of capital for fleet replacement need to be identified. For positive impact, the emphasis in aircraft improvements should be to allow for increased operating efficiency and improved environmental impacts (e.g., better fuel consumption, less noise) rather than higher speeds. As composite materials are used to achieve lighter weight aircraft, public concerns may arise about new compounds being released into the environment in unexpected ways.

The supersonic transport (SST) was one type of advanced air technology considered by some panels.* There is considerable doubt that noise (sonic boom) and environmental obstacles (upper-atmosphere pollution) can be overcome during this century. Introduction of the SST would serve national and foreign policy interests, but establishing sources of capital for development and implementation will be difficult.

Future of Rail Passenger Service Uncertain

Diverse views emerged at the Workshop on the future prospects and impacts of intercity rail service. One view holds that the transportation services provided by long-haul rail could be adequately handled by other modes and that a heavily subsidized mode should not compete with profit-seeking companies. Others hold that the service is in transition and has not yet had an opportunity to demonstrate its improved capabilities and attractiveness to travelers. In short-haul,** high-density travel markets, the prospects for improved passenger train (IPT) service appear good, although it was noted that public and political pressures could expand the service to unprofitable markets. Extensive upgrading to track will be required to implement IPT and studies are needed to determine the impacts that fast passenger trains would have on rail freight service.

In general, participants had misgivings about more exotic forms of high-speed ground systems such as tracked levitated vehicles (TLV). Their high capital cost and suitability for only a limited number of very dense travel markets are viewed as the basis for severe institutional as well as economic problems. Also cited were difficulties in obtaining right-of-way because of noise and safety concerns, political resistance generated by advocates of competing modes, and the need to overcome government jurisdictional problems.

Are Electric Highways on the Horizon?

A set of advanced technologies that provoked much discussion are electric-powered automobiles and electric/automated highways. In general, the prospects for these relatively undefined technologies appear to be dependent on the rate of development and eventual price of nuclear power generation; battery-powered automobiles for intercity travel are not judged likely because of range limitations. A critical unknown is the extent of overall (or fossil-fuel) energy savings, if any, afforded by electric highways. Much discussion centered on the means by

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*Others included short takeoff and landing aircraft (STOL) and very large (900-passenger) aircraft.

**Less than 500 miles.

which vehicles would receive power from an electrified highway and uncertainties regarding the effects of such a system--primarily, traffic safety and the potentially harmful public health effects of strong electric and magnetic fields created by the system. Start-up problems for electric highways are envisioned. Potential users would be reluctant to equip their vehicles if available routes were limited; at the same time expansion of routes might depend on demonstrated demand. Also, existing antitrust laws might make necessary standardization of vehicles difficult. A wide-ranging set of potential impacts that might occur with automated highways was generated by one panel (Panel 4); included are such considerations as the need for and impacts of traveler entertainment en route and the possibility of poor driving habits (e.g., speeding) upon leaving the automated system and reverting to manual control.

Access Can Be Improved

Many participants took the position that improvements in access and terminals can lead to substantially better intercity transportation service and would not require the massive capital outlays associated with new line-haul technologies. Noted in this regard were regulations in some locations that prohibit jitney services or service to airports by intercity buses. The diversity of existing problems among cities suggests that solutions might best be formulated on a case-by-case basis. Integrated (multimodal) terminals are cited as a goal and a decision is needed on what level of government should take a lead role in implementing the concept. One consumer viewpoint holds that there is a pressing need for door-to-door public intercity service, to create mobility for that large segment of the public which does not have access to an automobile. In general, however, Workshop participants had reservations on any potentially high-cost system.

Travelers Need More Information on Available Services

The view was expressed that better consumer information would enable travelers to use present and future intercity modes more effectively. In trip planning, it is currently difficult to identify all available travel options (both line-haul and access/egress) in terms of travel time and cost. Unresolved is the problem of providing full information without creating such complexity as to defeat the purpose. Also uncertain is whether carriers or a government agency should develop and operate the information system(s).

It was generally agreed that steps should be taken to provide better information to travelers while en route. More complete and more standardized displays of travel information are needed in air, bus, and rail terminals.

Labor Considerations Discussed

Comments about varying aspects of the "labor issue" arose repeatedly during the Workshop. One basic concern relates to labor productivity: changes in the work ethic may cause a decrease in future productivity. This might argue for increased automation of transportation systems. On the other hand, it is suggested that technologies which are purposely labor-intensive might be adopted in order to create jobs. At a minimum, consideration should be given to the retraining and employment of labor and management who are displaced when obsolete transportation services are discontinued.

Government Roles Debated

Government roles in intercity transportation were another recurring theme of discussion. Differing viewpoints on federal government involvement in basic research and technology development (R&T) were expressed at a special topic session. While the government has a clear role in R&T, it is not clear that this role should extend to specific product development.

In the area of regulation, it was generally acknowledged that government regulatory agencies can be formidable barriers to some forms of technological innovation aimed at operational efficiencies or service improvements.* However, it was argued that deregulation (the prospects for which are uncertain) might also negatively impact the implementation of new public transportation technologies. Extensive discussion took place on the prospects for government ownership of intercity modes and resulting consequences. Here, a distinction was made between full nationalization (which might lead to inefficiencies) and national corporations operating to a budget. Few arguments in favor of nationalization surfaced, but it was generally agreed that the prospect of capital scarcity increases the likelihood of government ownership for the rail and air modes.

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*At the same time, existing regulatory policy fosters some kinds of transportation innovation.

III. REPORTS OF ASSIGNED PANELS

This chapter contains a report from each of the Workshop's four assigned panels, prepared by the panel chairmen. Preceding each report is a sheet that lists the members of the panel* and an outline of report contents.

The membership of each assigned panel was established before the Workshop by the project team. In forming the groups, an objective was to include a variety of viewpoints on each panel; at the broadest level this included a balance of government, industry, and academic representation. As an indication of the diversity of backgrounds represented on each assigned panel, Appendix A contains brief biographies of study participants.

It was intended that the assigned panels follow parallel lines of inquiry in their several sessions. For this purpose, a suggested set of topics was prepared for each session and distributed before the Workshop. (See Appendix B.) The first two sessions of each panel were devoted to a review and discussion of project reports. (See Appendix C.) For example, in the second session each panel focused on one of the study's scenarios. The remaining three sessions were devoted to the assessment of impacts related to future intercity transportation options.

Table III-1 provides an overview of the transportation technologies addressed by the panels.

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*As indicated in Appendix A, three project team members were also present during each panel's sessions--an agency representative, a facilitator, and a team member providing staff support.

Table III-1

TECHNOLOGIES RECEIVING PRINCIPAL ATTENTION
BY PANELS IN IMPACT ASSESSMENT

	Panel			
	1	2	3*	4
Air				
Improved Conventional Aircraft		x		x
Very Large Aircraft	x			
Supersonic Transport (SST)	x	x	x	
General Aviation	x			
Guideway and Rail				
Higher Speed Rail	x		x	
Tracked Levitated Vehicles (Very High-Speed Ground Transportation)		x	x	x
Highway				
Improved Autos	x	x	x	x
Improved Bus		x	x	
Battery Autos	x		x	
Electrified/Automated Highways	x	x	x	x
Others				
Access/Egress and Multimode Passenger Terminals			x	
Travelers Information Systems			x	x
Dual-Mode Systems			x	x

*Panel 3 quantified impact data for several other technologies not checked here.

Assigned Panel 1

Panel Members

Frank Besson - Chairman
(U.S. Army, Ret.)

Robert K. Best
Chief Deputy Director
CALTRANS

Richard E. Black
Douglas Aircraft Company

James C. Goodridge
Connecticut General Life
Insurance Company

Lawrence P. Greene
Acting Director,
Office of R&D Plans and Resources
Department of Transportation

Norman Hummon
Environmental Systems Engineering
University of Pittsburgh

James R. Nelson
Amherst College

Thomas O'Brien
Engineering and Development
Federal Aviation Administration

Roy Pulsifer
Civil Aeronautics Board

William Spreitzer
Department Head
Transportation and Urban Analysis
General Motors Corporation

Clarence A. Syvertson
Deputy Director
NASA Ames Research Center

Organization of Panel Chairman's Report

Assigned Panel 1

Introduction

Panel 1 first discussed social and economic issues impacting on intercity transportation. The Panel, based on review of the technical reports furnished the panel and on individual background experience, prepared the following list of primary areas that would impact on or be impacted by the introduction of new technologies, irrespective of mode:

Investment Costs	Regulation
Energy	Labor
Fare Structure	Terminals--Ingress/Egress
Subsidy	Life-styles
Shifts in Population	Land Use

Investment costs and methods of financing received the greatest attention. The energy crunch was well recognized, but most of the concern about energy was related to the secondary place that intercity transportation would take with respect to energy in competition for investment capital. Other areas that provoked the most discussion were:

1. Overemphasis on line haul in study reports as compared to the problems of terminal access/egress
2. The changing pattern of distribution of population
3. Full cost fares vs subsidy

After discussing issues in the first meeting, the Panel in the remaining sessions addressed the reasonableness and utility of the scenarios, an approach to understanding impacts, and a list of observations and recommendations.

Scenarios

The consensus of Panel 1 was that the scenarios as proposed invited concerns on whether the transportation alternatives postulated were really related to their respective background scenarios.

The majority of the Panel accepted the scenarios, subject to certain reservations largely related to removing internal inconsistencies. Acceptance generally derived from acknowledgment that, although the scenarios are imperfect projections of what the real world will probably

be like, they do afford an opportunity to weigh alternative courses of development of intercity passenger transportation across a spectrum of possible worlds.

There was general agreement that a technological assessment requires *a priori* the establishment of a basis for comparing:

- The level of investment required, the source of that investment (public or private), and the degree to which that level of required support would be forthcoming in the light of scenario parameters. Corollary to the investment analyses are questions related to support of operating costs, i.e., the degree to which fares should bear full costs and the extent of governmental involvement--partial or full subsidization or even nationalization.

- The impact on energy requirements.

- Other impacts or influences including pollution, land use, regulation, labor relationships, life-styles or attitudes, and geographic distribution of population.

There was a request that, as a substitute for the issue/scenario/technology approach, consideration be given to the following procedure:

1. Extrapolate existing trends related to intercity passenger transportation.

2. Develop background scenarios based on various combinations of future economic, societal, regulatory, and technological changes that would result in modifying these extrapolations of intercity passenger transportation and thereby establish a transportation scenario for each background scenario.

3. For each of the resulting background scenarios, assess the primary and lower orders of impacts on the issues of concern.

This request, in the light of the current state of the assessment program, did not receive general support.

At the conclusion of the Workshop, it was almost unanimously agreed by Panel 1 that too much time has been spent on the scenarios. In the light of time constraints, the Panel might have been more productive if the postulated scenarios had been accepted as reasonable tools for the assessment effort and more time devoted to the subject of impacts. The scenarios did not really drive the Panel efforts to identify *impacts on society* resulting from introduction of technological advances. The impacts on society of technological advances (such as the supersonic transport [SST], tracked levitated vehicle [TLV], and automated highways) seem to be largely independent of scenarios. Of course, the attitudes, structure, and affluence of a future society will determine,

in large measure, the prospects and means for introduction of a new technology, e.g., how energy requirements and investment and operating costs will be satisfied. Scenarios are useful tools in addressing *what kind of society* would *support* and could *afford* a specific *technology*, but considerations of these factors seem to be more the province of the contractor team rather than subjects for consideration in this Workshop--where efforts were directed primarily to unusual, unanticipated, uncertain, and problem impacts on society.

Impacts

The Panel briefly considered the methodology outlined in Section IV of [draft] Technical Report #5 as a basis for identifying impacts of new technologies in intercity passenger transportation. It quickly became apparent that the methodology involved a matrix so extensive that the Panel could not make any reasonable progress in the time available. The possibility of using that methodology was therefore abandoned.

The Panel decided to assess impacts by mode of transportation.

The Panel agreed not to accentuate problems that were already identified, except where there were unique aspects that might not have been adequately addressed. Primary emphasis was placed on impacts that might otherwise have been overlooked. As noted, Panel 1 felt that what surfaced under the approach we adopted were really technology- and not scenario-oriented.

Observations and Recommendations on Technology Impacts

Automobiles. It seems probable that a short-term technological change necessitated by, for example, continued pressure of fuel costs to redesign the present automobile as a lighter, smaller, more energy-efficient vehicle, might require extensive retooling with a need for massive capital investment measured by traditional standards in the industry. The consequences of this change, which is currently taking place, are not known but the following major possibilities should be taken into account in determining the direction of public policy.

Industrial Organization. In *Case 1*, the industrial composition will become more concentrated (monopolistic) because existing marginal firms will be eliminated and new entry will be precluded by high capital requirements and risk. A trend toward monopoly would entail severe public policy problems in areas such as antitrust and labor monopoly. As a result, the long-term technological innovation rate may slow.

In *Case 2*, radical new technologies will encourage new entry (e.g., electrical equipment manufacturers might enter the market as producers

of electric cars). If this were to happen, the power of labor unions will be reduced leading to lower wages; the threat of government intervention on the economic side will be reduced; and the rate of technological innovation may increase through increased competition.

Capital Investment. In *Case 1*, private investment will finance the bulk of capital requirements. Market forces, as modified by possible changes in the degree of monopoly (see above), will determine the rate and extent of technological change. A reasonably long transition from current technology automobiles is implied.

In *Case 2*, government financing of retooling by various means (with or without full recovery of costs from the manufacturer and/or buyer of the end product) will accentuate the rate and direction of technological change. This case implies heavy government intervention or outright nationalization and, possibly, increased power of labor.

Demand Impacts. In *Case 1*, new technology automobiles will be lower in unit price (including amortization of capital costs) and lower in operating costs than vehicles were before the energy crisis. This implies wholly new automated production techniques, as well as radically improved vehicle technology. Depending on relative cost/convenience differences with other modes of transport (and all other goods and services to the extent they are substitutes), vehicle fleet size and automobile travel will increase significantly.

Case 2 is the converse of previous case (e.g., higher vehicle prices and higher operating costs relative to other modes and substitutes). This implies a relative decline of the automobile as a mode of surface travel.

Vehicle Specialization. All alternatives imply at least two basic types of car, based on city/local use and intercity highway use. This is taking place today and is likely to continue. Radical technological innovations based on specialization may be anticipated. Possible ways to accommodate the two automobile travel markets include such things as:

- Rental car systems of intercity vehicles
- Rental car systems of intracity vehicles with intercity travel restricted to public carrier modes
- Electrified highways that provide the power for the intracity vehicles
- A pallet system for carrying the intracity vehicles over long distances

The impact on the national economy of major changes in the automobile manufacturing industry is sufficiently important to warrant an in-depth study of this particular area.

Impact of an Electrically Powered Automobile. Massive introduction of electrically powered automobiles will raise serious problems in other industries which provide (or might provide) major imputs to the manufacturers of automobiles. For example, major inputs might include steel, copper, aluminum, and plastics to reduce weight (might have a significant impact on the energy industries).

In addition, there may be unforeseen environmental impacts from electrical automobiles such as disposal of used batteries and electrical power for recharging and associated gaseous by-products of the recharging process.

The Panel recommends research on the dimensions of the problems of resource availability and/or substitutability options associated with any recommended changes in automobile design.

Impact of Smaller Automobiles on Highways. A larger number of smaller automobiles in service might afford an opportunity to alter and facilitate traffic flows by narrowing highway lanes (and thereby increasing the number of lanes on existing highways). Obviously, this opportunity could only be applied to selected areas on multilane highways because standard width lanes must be retained to accommodate bus, truck, and other wide-vehicle traffic.

The Panel recommends research in the area of the feasibility of increasing highway utilization by varying the lane widths on existing highways to accommodate small automobiles and wider vehicles operating at different speeds.

Impact of Accelerating the Trend Toward Smaller Automobiles. If there is a significant trend toward replacing large automobiles with smaller ones or replacing petroleum power by electrical power, there may be an impetus, from the standpoint of energy conservation, safety, and pollution, to accelerate the rate of changeover. Such an acceleration could prove destabilizing to the industry and economy by causing overtooling and thereby pyramiding the requirements for start-up capital investment, putting labor in a feast followed by famine regime, and endangering the timely establishment of an efficient and responsive maintenance support structure for the new automobiles.

The Panel recommends identifying and analyzing the various forces that might tend to unduly accelerate the transition from one vehicle design to another and what those forces and/or transition would mean to the economy.

Impact of Electrified Highways on Energy Requirements. Electrified highways might accentuate normal peak demands for electrical energy in many urban areas. When installed in these critical areas, the electrified highways would have to carry the capital expenses associated with increased power generating capacity.

The Panel recommends analyzing the possible peaking patterns and making sure that ongoing studies of electrified highways include consideration of peak power requirements.

High-Speed Ground Transportation.

Impact of 150-mph Improved Passenger Train on Shared Tracks. There is extensive foreign experience in operating passenger trains at speeds approaching 150 mph, and there have been and are some serious problems. These problems should be documented and weighed in any improved passenger train (IPT) program. It may be that, realistically, 150-mph IPT service may require dedicated tracks, whereas a slower (e.g., 120-mph IPT service) could be compatible with freight service on shared tracks.

Studies should concentrate on realistic trade-offs in establishing an optimal breakpoint for the speed on an IPT system.

Impact of Rail Production Capacity on IPT. Extensive introduction of an IPT system will require an accelerated program to overcome years of deferred track maintenance. U.S. rail production (e.g., the steel industry) capacity is inadequate to support such a program, and there may have to be heavy reliance on foreign production of rail.

The Panel recommends investigating the steps necessary to establish *competitive* U.S. sources of rail production, adequate to support a necessary level of track maintenance.

Impact of Other Modes of Continued Government Subsidy of Rail Passenger Service. Government subsidy of rail service gives it an economic advantage over competing services furnished by self-sustaining private enterprise. This economic advantage tends to artificially shift demand away from more economical private enterprise and inhibits innovation in these modes. There might also be a tendency for continued governmental subsidy of rail transportation to inhibit the extension of credit by private sources to the other modes of transportation where competition on parallel routes is involved.

The Panel recommends economic analysis of the impact on competing modes of transportation when one mode is subsidized with public funds.

Impact of IPT on TLV Development. IPT may be economically viable in certain markets, but there will undoubtedly be public and political pressures which could lead to relatively widespread construction and implementation of costly IPT systems in unprofitable areas. An existing IPT service on a broad scale might delay and even eliminate the introduction of TLV.

The Panel recommends research on the relative values of IPT and TLV (e.g., their ability to satisfy projected demand levels) with recognition of the different time frames involved with each.

Air Systems.

Some Observations on the SST. Despite substantial discussion about the SST, Panel 1 could not develop any important impacts that are not already known, studied, or under consideration. The Panel did want to record the following observations that may be helpful in these on-going studies:

1. It is doubtful that the study assumptions that the sonic boom problem and reasonable energy consumption per passenger mile will be realized by the end of the century.

2. The time/range advantages of the SST will extend the average trip length which should be a positive factor in increasing the community of interest between the U.S. and more distant destinations (e.g., the Far East and South America).

3. A major positive argument for the SST is the balance of payments. This may be important once an economically viable SST is developed, particularly if the development occurs outside the U.S.

Giant-Jets. The Panel noted that the heavy concentration of passengers associated with the use of giant-jets will complicate access and egress problems (1) within the airplane (possibly causing emergency exit problems and slowing its certification), (2) at the airport gates, and (3) to and from the airport.

Since access/egress was explored in a special topic session, no further comments are offered.

The Panel observes that the collection/feeder problem for high capacity aircraft may establish the *requirement for short-haul aircraft and/or helicopters*, even though they might operate only at premium fares.

Impact of an Expansion of General Aviation Activity. Prospective continuation of the rapid expansion of general aviation will result in major problems with present air traffic control capabilities.

The Panel recommends a study of the requirements for upgrading secondary airports, and possibly using some capability at military bases, to support the expanding general aviation fleet and preclude increased delays at major hubs.

Additional Issues--Regulation of the Automobile Manufacturing Industry. Application of the present antitrust laws and policies in the "traditional" manner relative to the automobile industries may serve to thwart, rather than support, certain technological innovations which may seem desirable in the context of the development of new forms of transportation. For example, where the electric highway is concerned--and to lesser extent, the electric automobile--there will be an unprecedented degree of commonality between vehicles manufactured both by the same firm and by competitive firms in order to achieve the technological compatibility necessary, especially if the transition to electric power is to be swift. At present, antitrust constraints limit what competitive manufacturers can do to achieve the requisite standardization which represents a potential and generally unanticipated barrier to such an innovation. This subject probably warrants an in-depth analysis.

Assigned Panel 2

Panel Members

Larry H. Day – Chairman
Supervisor, Business Planning
Bell Canada

Leon M. Cole
Congressional Research Service
Library of Congress

F. Jerome Hinkle
Systems Analyst
Energy R&D Administration

Melvin Kranzberg
Callaway Professor of the
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Dan Maxfield
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Robert W. Rummel
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Trans World Airlines, Inc.

Anthony C. Taylor
Science Consultant
U.S. House of Representatives

George Wickstrom
Director of Technical Services
Metropolitan Washington Council
of Governments

Organization of Panel Chairman's Report

Assigned Panel 2

Introduction

The discussion of Panel 2 fell into two distinct phases. The first two sessions followed the outline shown in the conference schedule with the various questions being addressed. These meetings are reported upon with a normal summary of the verbal discussions. The last three sessions were quite different as a structured approach to group dialogue was followed. The technique of cross-impact analysis was utilized to help focus, structure, and quantify the impact discussions. These sessions are summarized here through an analysis of the matrix produced by the group.

This report will not attempt to elaborate upon any of the 145 impact interactions considered by the group. Detailed records on each of the votes conducted by the group were kept, and this material is available to the study team. This is important supporting data in cases where consensus on a particular issue could not be reached by the group.

The support data includes brief records of the pro and con discussions in the unresolved areas.

Session 1, Issues and Scenarios

This session began with the question of "why were scenarios used at this stage of the study?" This led directly to some general comments on the scenarios themselves. Some of these included:

1. There was not a clear distinction between what were dependent and independent variables.

2. The scenarios were insensitive to some developments.

3. Polarizing scenarios can help since they outline goals to plan for or outcomes to plan to avoid.

4. A "stagflation" scenario was needed.

5. The scenarios should have been quantified in key areas; words like "more, big, better, moderate," etc., do not provide enough guidance.

6. Consumer needs or attitudes were a necessary input to the scenario process.

7. Other stakeholders should be identified in the scenarios.

After the general discussion, the group faced the decision of either: (a) getting to a more detailed evaluation and criticisms of the particular scenario, or (b) taking a more macro approach to the study and identifying the issues that the group felt were important.

The latter path was taken during the session. The group produced a list of the issues that it felt was important to the future of intercity transportation.

The items shown on the list reflect the summarization of complex questions into a few code words meaningful only to the group. The list was regarded as a launch point for future discussions of impacts. The list of problems and issues is tabulated below.

1. Supply of venture capital

2. Technological evolution vs revolution

3. Technology innovation

4. Energy cost impact (operating costs, capital, clean-up)

5. Institutional inertia

6. Policy contradictions

7. Individual vs group values

8. System interfaces

9. Inflation/unemployment/stagnation (level of economic activity)

10. Urban growth patterns

11. Leisure patterns

12. Regulatory/subsidy issues

13. Air pollution/ecological issues

14. Access/egress/amenities

15. User needs definition (by whom?)

16. Transport industry structure (nationalization?)

17. Shortness of political planning horizon (corporate planning horizon)

18. Travel/communication substitution?

19. Regional resource costs/benefits -- who pays?

20. Synergistic secondary effects

21. Impacts of fiscal/monetary policy on transportation

22. Present constraints on future choices

23. Overhead maintenance (productivity improvement)

24. Labor issues

25. Desired level of mobility (cost justification)

26. Appropriate (?) share of GNP for transportation

27. Transportation safety

    (a) Product safety

    (b) Operating safety

    (c) Guideway/design

28. Govermental jurisdictional issues

29. Obsolete operating procedures

30. Antitrust issues (transportation companies?) ("common carrier" alternatives)

31. Cross-subsidy issues

32. Land use patterns/policy values

33. National interest considerations

    (a) Foreign ownership

    (b) National Security

    (c) U.S. prestige

    (d) Technological leadership

34. Equity vs efficiency

35. Demographic influence

36. Technological promise vs reality (risk assessment)

37. Problems of scale

38. System(s) perpetuity (disinvestment)

39. Technological alternatives

40. Technology transfer/diffusion

Session 2, Scenario II

The initial efforts in the session were directed toward attempting to group the 40 issues developed in Session 1 into collections of similar issues. These groups of issues would then be compared to those presented in Scenario II (background and transportation). This effort did not receive any strong acceptance and was dropped.

The session then drifted over a number of general items associated with the scenarios, and Scenario II in particular. Dissatisfaction with this led to the plan of review of the items in Transportation Scenario II and their relationship to Background Scenario II.

The most recurring point was what could be called the capital issue. Scenario II assumes that big business and big government (i.e., federal government) are restrained. This leads to a considerable loss in the ability to develop the large capital pools needed to fund new technology

introductions. This capital formation function is one of the key roles of business and governments, and it appears impossible or unlikely in the environment postulated in Scenario II.

The group noted that big research and development (R&D) efforts (especially "D" ones) did not appear consistent with the anti-big thrust of Scenario II. It was unlikely that major new technology development programs would be developed in an environment when there aren't any clear "consumers" in the corporate and government fields.

It was also noted that new technologies would still be developing on an international scale, and they could be bought by U.S. carriers even though they might not be developed in the U.S. International competition would force this to occur with potentially serious results for the U.S. balance of payments, national prestige, etc.

The last point in this area of the discussion was the point that Scenario II would result in local and state transportation system developments which might not be in tune with national needs. The question of financial ability of the local areas and states to take this lead was also raised.

The following comments indicate the group's consensus on the various transportation modes *as they relate to Scenario II.*

Air.

Commuter Air Service. Questions of definition were raised initially. There was also the point of defining what were the existing levels of this service that were "increased." All-in-all, the group was not impressed with the importance of this development since commuter airlines would still only represent a small portion of intercity transportation traffic even in the year 2000.

Improved Conventional Takeoff and Landing Aircraft (CTOL). This was considered to be a new generation of improved versions of DC-10s, 1011s, 747s, that would incorporate new design features but would not be "new" from the point of radical departures from existing aircraft. The time frame concerned was the late 1980s to mid-1990s when the existing stock of aircraft would be obsolete and uneconomic to fly or maintain. Scenario II was considered incomplete since it did not address the issue of how this replacement program would be financed (note earlier comments) in an anti-big environment. This was an issue (replacement) that could not be ignored since it would occur, no matter what the future political scenario might be.

General Aviation. This was accepted as given and not considered to be a major item.

New Airports in Medium Cities. The scenario did not address a few issues of concern to the group. These included impacts on land use around cities, how could or would the cities finance these airports since the federal government would not be able to, and would this be an allocation of scarce local resources?

SST. The group felt that this should have been in the scenario even though it was a rather unlikely event without serious international competition (noted above). The R&D postulated in the scenario (considered unlikely by this group) could have solved many of the economic, technological, and environmental issues associated with the SST in the next 25 years. Hence, the group felt that it should have been considered in the overall scenario in order to complete the look at air transport.

Rail.

AMTRAK Discontinued. This did not concern the group since it assumed that AMTRAK's longer-haul business could be handled by other modes and that short-haul passenger rail service would continue in some manner.

Private, Specialized Rail, One Car. This was perceived to have little impact on the overall area.

TLV. Again this was added for review by the group after some debate. It received little enthusiasm except for some potential trials. Nationalization of roadbeds lead to an unresolved question of whether or not TLV vehicles might use the same rights-of-way.

Improved Rail Service (IR). This was added as a consideration since IR might serve some of the short-haul, nonmajor center needs that would develop in the decentralization scenario.

Railbus. This was also added as a long-shot service for some intermediate travel in the decentralization scenario.

Bus. The overall observation was that bus transportation was a "winner" in all of the scenarios. It appeared to be independent of the postulated environments, and this was regarded as a relatively healthy (financially) sector. The 10-inch increase in bus width was regarded as not too important. The importance of providing better terminal facilities, intermodal connections, and access was stressed if this was

really to succeed. This was seen as a possibility in the city/state dominated environment.

Auto.

Efficient Auto. This was considered to be the most underrated item in all of the scenarios. A small car with good fuel/pollution/economic characteristics has to be developed. How this would occur in Scenario II was uncertain. Foreign competition and development was discussed as one possibility. It was felt that the reaction in big business would almost guarantee that Detroit was not a major force in developing the electric auto. However, the big firms would not be able to freeze out the little ones in this environment. The use of electric autos for intercity was dependent on an unknown breakthrough in the energy field (perhaps based upon the R&D postulated in Scenario II).

Special Rentals. The big problem here was the resistance of the insurance companies to the proliferation of this type of business. The anti-big-business environment might help break down this type of barrier.

Access/Egress. This was considered to be a very independent area versus all of the forms of transportation. Integrated terminals were discussed as one goal. Problems with existing integrated terminals were noted (Frankfurt, Dallas-Fort Worth) as what to avoid. This should have been addressed more in this scenario since it was often a local issue and city/state governments were the dominant ones here.

Sessions 3, 4, and 5; Cross-Impact Analysis

As noted, these sessions involved an extensive cross-impact exercise. The group decided to use the set of issues developed in Session 1 and use them to evaluate several key transportation technologies. The large number of issues to be discussed forced us to choose a small set of the technologies for detailed evaluation. The ones that were finally used were deliberately picked to be a blend of air and ground transportation services and ones that involved significant changes from today's technologies. They were also ones in which the sponsoring agencies would appear to have a significant interest.

The cross-impact analysis was an extremely modified version of a "normal" one. In a normal analysis (where the appropriate amount of time is available), each of the issues and technologies is examined in relation to each other. In our case of 29 final events and 5 technologies, this would involve a 34 x 34 cell matrix. Time constraints forced us to make a number of important modifications to the process.

Modifications. The 40-odd issues were first reduced to 29 issues. The social issues, not the technologies, were determined to be the focal point for the analysis. The basic assumption of the group was that broad social issues will determine whether or not the technologies will ever attain widespread use. The analysis should be continued by the study team to fill in the rest of the matrix in order to determine the flow of impacts from the technologies if they attained widespread use, as well as the cross impacts between the issues and between the technologies themselves.

Basic Assumptions. The analysis was conducted with two basic assumptions. The first was that everything would be considered from the perspective of the year 2000. The second assumption was that large-scale system introduction of the new technologies was the aspect under consideration, not just the development of demonstration projects.

The Process. The process of the analysis followed a number of steps. The first step was to estimate the probability of each of the issues (i.e., events) or technologies occurring. This is called the "prior probability" in the matrix. This probability is the average of the group members' estimates of an event occurring, all things considered. It can be used to weight the various impacts developed in the matrix.

The next stage (which consumed about ten hours for the group) was to fill in the matrix. Each issue was assumed to occur (given a probability of 1.0), and the impact of this occurrence on the given technology was rated by the group. The rating scheme used is shown below:

3 = Very strong impact

2 = Medium impact

1 = Moderate impact

0 = No impact

+ = Increases likelihood of system introduction

– = Decreases likelihood of system introduction

The ratings in the matrix (Table III-2) are the averages for the group members. In some cases, a consensus was not reached, and the average is misleading. In those instances, the range is also shown in the matrix cell (i.e., +3-3). As noted above, the raw data of the group's votes, as well as capsule opinions, were preserved for future analysis by the study team.

Table III-2

ANALYSIS MATRIX

Issue/Future Event	Probability of Issue/ Future Events	Modes: SST (.57)*	TLV (.39)*	Improved Auto (.94)*	CTOL (.87)*	Improved Highway (.58)*
1. Restricted Venture Capital Supply	.62	-2.5	-2.5	+0.1	-1.4	0.0
2. Energy Prices Increase	.81	-2.3	+0.1	+1.7	+0.5	+0.9
3. Institutional Inertia	.74	-1.1	-2.0	-0.1	+0.3	-1.1
4. Internal Government Policy Contradictions	.76	-2.3	-1.5	+0.3	+0.2	-1.0
5. Quality of Life Prevails (environmental groups)	.59	-2.2	-0.3	+0.4	+0.8	-1.0
6. Good System Interfaces Developed	.52	+1.1	+1.6	-0.2	+1.1	+1.0
7. Stagflation Continues	.42	-1.5	-0.9	-0.1	-0.8	-0.9
8. Decentralization Occurs (two ways)	.59	-0.6	-0.1	+1.7	+0.2	+1.0
9. Great Increase in Leisure	.54	+1.1	+0.8	+2.1	+1.6	+1.5
10. Deregulation Occurs	.46	-0.6	-1.4	+0.4	-0.9	-0.4
11. Environmental Standards	.65	-0.4	0.0	+2.3	+1.4	-0.6
12. Transportation Industry Structure Nationalized	.35	+0.8	+1.5	+0.1	+0.2	-0.2
13. User Needs Become Well Defined	.50	+0.7	-0.5	+1.3	+0.8	+1.4
14. User Attitudes and Habits Remain Unchanged	.61	+0.6	-0.8	+2.8	+1.5	+0.5
15. Politicians, Businessman Have Short Planning Horizons	.77	-0.2 (+3-3)	-0.7 (+3-3)	+0.3	+0.5	+0.3

Note: Asterisk (*) denotes Panel's estimate of modes' probability of implementation.

Table III-2 (cont.)
ANALYSIS MATRIX

Issue/Future Event	Probability of Issue/ Future Events	Modes: SST (.57)*	TLV (.39)*	Improved Auto (.94)*	CTOL (.87)*	Improved Highway (.58)*
16. Dramatically Improved Communications	.74	+0.5	0.0	-0.1	+0.7	+0.9
17. Federal Subsidy of ICT	.73	+1.6	+1.9	-0.4	+1.6	+0.7
18. Regional Interests Predominate	.52	-0.3	+0.5 (+3-3)	+0.9	0.0	+0.5 (+3-3)
19. Reduced Labor Productivity in Transportation (big spread)	.63	0.0 (-2+3)	+0.8 (-2+3)	+0.4 (-2+3)	-0.4 (-2+2)	+1.5 (-1+3)
20. Passenger Transports Share of GNP Declines	.41	-0.6 (-3+3)	-1.2	+0.2 (-2+2)	-0.5	-0.3
21. Safety Requirements Maintained/Increased	.80	-1.2	+0.6	0.0	+0.4	+1.6
22. Jurisdiction Issues Continued	.82	-1.3	-2.1	0.0	-0.2	-0.7
23. Obsolete Operating Procedures Continue	.61	-1.0 (-2-0)	+0.2	+0.4	-0.5	+0.5
24. Active Antitrust Actions	.46	-1.2	-0.1	-0.2	-0.2	+0.1
25. Common Carrier Concept Continues	.72	+0.5	+0.4	-0.4	+0.6	-0.1
26. National Policy to Depopulate East and West Coasts	.26	-1.0	-1.3	+1.7	+0.3	-0.7
27. National Foreign Policy Interests Prevail	.60	+1.8	+1.0	+0.5	+1.7	0.0 (+3-3)
28. Equity is More Important than Efficiency	.61	-1.9	-0.1	+1.7	-0.7	0.0
29. Discount Rates Increase Dramatically	.60	-1.5	-2.0	0.0	-1.5	-1.1

Note: Asterisk (*) denotes Panel's estimate of modes' probability of implementation.

Matrix Analysis. The material in the matrix can be analyzed from two perspectives. The first is to examine the intensity of a particular event or issue across the range of technologies considered. The intensity of an impact should be balanced against the probability of the event happening. Hence, a 1.5 impact of an event with a 0.80 probability is more relevant than a 2.0 impact of a 0.4 probability event. Thus, by reading across the rows, the importance of various events can be compared. The next section represents the group's conclusions on the importance of the various events across the range of technologies.

Impacts.

1. All big technology programs will be negatively impacted where large capital formation is required in an economy with a shortage of venture capital. (Improved autos are an exception since capital formation occurs with individuals.)

2. A significant increase in energy prices will decrease the likelihood of SST system introduction. This (energy price increase) will favor the development of improved autos. The latter point was regarded as counterintuitive by some members.

3. Institutional inertia will substantially decrease the possibility of *new* technological system introductions (SST and TLV).

4. Government policy contradictions will considerably decrease the chances for new technology introductions (SST and TLV).

5. Environmental groups' pressure (in "quality of life" issues) decreases the possibility of SST and improved highway system introductions.

6. Successful introduction of new systems will require good system interfaces to existing infrastructure.

7. Stagflation continuance will decrease the chances of new system introduction.

8. Decentralization to urban areas and smaller centers will relatively favor autos and improved highways over the other technologies.

9. Great increases in leisure time favor all intercity transportation systems, especially improved auto, highway, and CTOL.

10. Deregulation will have a negative impact on new public technologies but not on the auto. It was pointed out that this is against the conventional wisdom in transportation analysis.

11. If government maintains or increases environmental standards, this will favor improving old technologies rather than introducing new ones.

12. Nationalization of the transportation industry will favor the introduction of new technologies more than improving old ones. This was also regarded to be against the conventional wisdom.

13. Development of means that permit the definition of user needs accurately will favor the improved auto and highways. There will be little impact on other systems. Some disagreed with this analysis.

14. If user attitudes and habits remain relatively unchanged, existing technologies (improved auto and CTOL) are favored over new ones.

15. The existence of a short-term planning horizon in business and government will be relatively irrelevant to intercity transportation (ICT). The panel was somewhat divided on this result with others pointing out that this was against the conventional wisdom.

16. Telecommunications substitution for travel does not impact on the development of new ICT technologies.

17. Government subsidies will favor public systems over individual (auto) ones.

18. The impact of regional (state and city) interests on ICT was not resolved. This is an area requiring new research.

19. The impact of reduced labor productivity on ICT was very polarized and, hence, averaged out in the matrix, another area for further research.

20. A decline in the transportation sector's share of GNP will impact more on TLV system development than other systems.

21. The maintenance and increase of strict safety requirements will impact negatively on SST system development. This is a supporting factor for improved highway system development. (One panel member disagreed with the group consensus.)

22. Federal (state) local jurisdictional issues will block new (SST and TLV) system introductions.

23. If obsolete operating procedures prevail, then SST introduction is less likely.

24. Antitrust action in the transport industry will reduce chances of SST system introduction, since big companies will be required to introduce it.

25. Common carriers will continue to dominate ICT.

26. A national policy of depopulating the East and West Coasts in favor of the center of the country will favor the improved auto and discourage new technologies (SST and TLV), even though it is a highly unlikely policy.

27. National security and foreign policy issues are still a strong supporting element for introduction of new ICT technologies except automated highways. (A dissenting opinion was that improved highway technology could also be imported.)

28. Interest in issues of equity more than efficiency favors the improved auto and disfavors air technology.

29. A dramatic increase in the discount rate will reduce the possibility of all new public transportation technology being introduced.

The second form of analysis is to examine the technology columns in the matrix. This analysis helps show which events will increase or decrease the chances of a particular technology being developed. Thus, if for example, we were interested in promoting a particular technology, the matrix shows the restrictions to be overcome or the actions to be taken to help increase the chances for that technology to be adopted. The quantification of the impacts also helps indicate the importance or intensity of the events in question. This approach is far more useful than the "catalog of impacts" approach which can develop large lists of positive and negative impacts but not guide the assessor in determining which ones are the most important.

The following tables summarize the key positive and negative events as they relate to each technology. The "important" events were those assumed to be 1.5 or higher on the 3-point scale. Tables III-3 and III-4 examine the "big new technologies" considered by the group--SSTs and TLVs. Table III-5 examines the impacts on the improved CTOL. Tables III-6 and III-7 examine improvements in the automobile system.

Cross-Impact Analysis: Some Cautionary Comments. The analysis conducted by the group is not regarded as unique or perfect. This form of group dynamics suffers from disadvantages as do all forms of group opinion collection and analysis. As noted, averages can hide the range of opinions that exist in the panel. We have tried to overcome this by

Table III-3

IMPACTS ON SST

Positive	Negative
Federal Subsidy of ICT (+1.6)	Restricted Venture Capital Supply (-2.5)
National and Foreign Policy Interests (+1.8)	Increase in Energy Prices (-2.3)
	Internal Government Policy Contradictions (-2.3)
	Equity More Important than Efficiency (-1.9)
	Dramatic Increase in Discount Rates (-1.5)
	Stagflation (-1.5)

Table III-4

IMPACTS ON TLV

Positive	Negative
Good Systems Interfaces (+1.6)	Restricted Venture Capital Supply (-2.5)
Transportation Industry Structure Nationalized (+1.5)	Institutional Inertia (-2.0)
Federal Subsidy of ICT (+1.9)	Internal Government Contradictions (-1.5)
	Jurisdiction Issues Continue (-2.1)
	Discount Rate Increases Dramatically (-2.0)

Table III-5

IMPACTS ON CTOL

Positive	Negative
Great Increase in Leisure (+1.6)	Dramatic Increase in Discount Rate (-1.5)
User Attitudes and Habits Unchanged (+1.5)	
Federal Subsidy of ICT (+1.6)	
National and Foreign Policy Issues (+1.7)	

Table III-6

IMPACTS ON IMPROVED AUTO

Positive	Negative
Energy Prices Increase (+1.7)	
Decentralization Occurs (+1.7)	
Increase in Leisure (+2.1)	
User Attitudes and Habits Remain Unchanged (+2.8)	
National Policy to Depopulate East/West Coasts (+1.7)	
Equity More Important Than Efficiency (+1.7)	

Table III-7

IMPACTS ON IMPROVED HIGHWAYS

Positive	Negative
Great Increase in Leisure (+1.5)	
Reduced Labor Productivity (+1.5)	
Safety Requirements Maintained or Increased (+1.6)	

collecting all of the data. Particular points of view, vested interests, or unique perspectives can also get washed out in this form of analysis. However, normal group sessions can also result in the domination by the loud, aggressive, or eloquent members of the group, and other opinions will get submerged.

The results of a cross-impact analysis act as a mirror to the collective opinion of the group assembled. The collective opinion changes with the composition of the group. Hence, counterintuitive results can either be the result of the unique insight of the particular group assembled *or* their lack of knowledge in a particular area. It is difficult to assess which is the case in this or any other group.

Participation in a cross-impact session is often regarded as quite rewarding (after all the work is over!) by the group members. This can be an interesting educational and communication experience. A key difficulty is the transfer of this experience and its resulting information to the consumers of the group's product. The transfer process in the NASA/DOT study may be facilitated somewhat by the fact that three members of the study team were actively involved throughout the three cross-impact sessions.

Conclusions

The specific conclusions of Panel 2 are contained in the matrix and the above analysis. On a broader scale, the group left behind two additional contributions to the study team. The first is the actual "data base" from the exercise itself. This can be reanalyzed from different perspectives that may be more relevant to the study team. Secondly, the group attempted a process of group dialogue that may be of value to the study team and the sponsors. Cross-impact analysis can be used in future phases of the study to capture and quantify the diverse views of the study team and sponsoring agencies. The methodology can get much more sophisticated, complete with computer analysis, than was possible in our short time at Hershey. The methodology utilized by the group may end up in the long run to be far more important than the information left behind.

Assigned Panel 3

Panel Members

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AMTRAK

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Organization of Panel Chairman's Report

Assigned Panel 3

Session 1

Social and Economic Issues To Be Addressed. How can fragmentation and/or uncoordinated approach to energy and environmental problems be overcome? And how instilled in business and governmental leadership is the absolute need to make the general public aware of all the ramifications of the energy shortage and environmental problems?

How can the favorable support of the voter be enlisted, especially in view of the decreasing number of voters and the problems of credibility? Other issues to be addressed include:

- The adequacy of available capital, both private and public.
- The establishment of priorities for capital allocation.
- Regulation of the flow and allocation of capital through the relationship of fares to energy cost including imposition of taxes.
- Labor and its response and reaction to technological change.
- The psychological implications of marketing transportation modes.
- Prior conditioning of transportation choice based on position in the economic system.
- The effect of the caste system.
- How to make intercity transportation available on an equitable basis to all elements of society.

Range of Possibilities To Be Added. Is there sufficient redundancy in the intercity transportation system to provide adequate capacity in the future in the case of a major disaster such as an earthquake or a limited war? What direction will regulation take, how will it be performed and in what style? How much oil will be available? Who is the customer for intercity transportation? What are the socioeconomic impacts of transportation systems and the restraints imposed on transportation by land use legislation? How is demand governed by price level of transportation?

Innovations To Be Considered. These include:

- Intermodal ticketing and intermodal transportation companies.

- Innovative car rental programs enabling the consumer to contract for use of automobile at any place and time.

- Consumer information system on availability of multimodal transportation with information or education on how to use the transportation system.

- Better use of existing systems by providing incremental improvements which would result in greatly increased quality of service.

- Necessity for broad industry participation in research and development activity in connection with new transportation technology, not limited to a single company.

- Explore use of the compound helicopter.

In the extensive discussion on the consequences of nationalization, concern was expressed over the fact that "when bureaucracy steps in, you are not going to have efficient management." The key point was seen as who does the managing. There is a "colossal difference" between a national corporation trying to break even and a nationalized system run with civil servants.

Though it was agreed that private sector management is most desirable, general fear was expressed that, based on the past, that is not the direction in which we are headed.

The task of watchdogging nationalized transportation systems is hindered by the fact that there really is no organized constituency of transportation consumers. One method of providing checks and balances would be through dividing the operation into regions.

Session 2

Panel 3 listed those elements of Scenario III requiring change and those requiring clarification or expansion.

1. Elements of Scenario III to be changed:

   - Clarify semantics of nationalized railroad, national corporation, and ConRail

   - When is the change from AMTRAK (semipublic corporation) type to British Rail type of nationalized system contemplated?

   - Technology is adopted which is purposely labor intensive in order to create jobs.

- Development of nuclear breeder-reactor technology will take more than the ten years allocated in timetable to be significantly productive for high electrical energy users.

- The timetable for technological development seems to imply an undoing of some energy research.

- Anticipating low prices for natural resources may be unrealistic

- Coal makes poor jet fuel, and perhaps should not be considered as a source.

- The report may be overly optimistic about the possibility of overcoming regulations that inhibit efficient transportation systems. Restraints imposed by regulation are of such significance that they would warrant some research by NASA.

2. Elements of Scenario III To Be Clarified or Expanded.

- Will there be adequate public transportation available if the private auto use is reduced by 50%?

- Will fuel use restrictions be placed on recreational vehicles, marine, and general aviation except when shown to be business, or when public transportation is not available?

- The fuel price used to drive the technological development programs should be that perceived for the midpoint of the scenario--1987 and not 2010.

- Will the timing of reduction in air service between smaller cities follow the same long drawn-out pattern experienced by rail discontinuance? Will it be subjected to political pressures?

- All the costs and impacts of liquid hydrogen technology are not acknowledged. This includes extractions, energy costs, handling, storage facilities; safety discipline in use.

- How to cope with regulatory problem (state and federal) and political problem to adopt a wider bus body?

- Need to have safety and environmental recommendations reviewed by objective, technically strong group to insure economic effectiveness. Also research must be funded to provide technology.

- How can bus subsidies be originated to keep bus fares available to the economically disadvantaged?

- Who will perform audit of effectiveness of management or adequacy of performance of national air, national rail, AMTRAK, subsidized bus transportation? How should corporations be organized?

- There is a need to establish firmer direction for implementing the intermodal terminal concept. Decision needs to be made on what governing agency should be responsible for creating the terminals.

- It was observed that most research and technology (R&T) for intercity buses is being carried out by private enterprise, which seems to want to keep it that way.

- It is not reasonable to suppose that a whole new fuel technology will be generated to cover a ten-year crisis.

Sessions 3, 4, and 5

Panel 3 approached the technology assessment through a matrix representing various technologies vs various impacts. A 7-point scale of plus/minus 3 was used by the individual members to rate the impact. The large negative impacts were judged to be most adverse; large positive impacts were deemed helpful, desirable, advantageous. No perceived impact was judged as "zero." Each panel member graded the impacts on technology, and vice versa, in private. The results were then accumulated and summarized in Figure III-1.

Adopting a semi-Delphic oracle approach next, the panel reviewed the posted individual ratings. Where the distribution of the weighted ratings was narrow, consensus was proclaimed. Where the weighted ratings were very broad, discussion generally yielded a consensus, the participants being given the opportunity for determining what the consensus rating should be. When the distribution of weighted ratings revealed polarized views, further technical, economic, social, or psychological reviews were held. Usually, the polarized ratings resulted from a misunderstanding on a basic concept or fact. In a few instances, the polarization resulted from the members' very strongly held views on a specific technology/impact relationship. Where this occurred, this singular view is reported in the text.

Review of Figure III-1 shows the identified technologies ranked from 1 to 20 in terms of most favorable effects on the impacted areas. Likewise, those areas having the highest impact on future technology are ranked in descending order from 1 to 11.

Figure III-2 is a partial reproduction of Figure III-1, showing only the major positive areas of impact/technology interaction. It is clear that the improved bus, the electric auto, and the improved passenger train rate very high as technologies which will produce the most beneficial impacts.

IMPACTS	IPT	TLV	Auto Transporter	Moving Rendezvous	High-Speed Aircraft	SST	Medium CTOL	Small Aircraft	Compound Helicopter/VTOL	Electric Car	Electric Highway	Conventional Car	Improved Bus	Omni-Rental	Multiple Right-of-Way	Collection Distribution System	Information System	Intermodal People Containers	Multimodal Terminal	Communications vs Transportation	TOTAL
Secondary Economic Effects	1.25	.83	.33	.91	.50	0	.58	.75	.75	1.09	.55	.08	1.17	.67	1.20	1.10	.82	.50	.92	.55	11.55
Noise/Air Other Pollution (Congestion)	1.33	-.67	.92	.36	-1.00	-2.33	-.42	-.67	-1.75	2.18	1.09	-.50	1.00	.67	.70	.70	.55	.30	.17	2.64	5.27
Regional Development	.33	.58	.33	.73	.33	.08	.33	.92	.58	.64	.91	.25	1.17	1.00	.90	1.00	.45	.20	1.00	.18	11.91
Personal Mobility Access	1.08	1.33	1.08	1.18	.50	.67	.92	1.33	1.17	1.45	1.09	1.25	1.58	1.67	.70	1.73	1.82	.90	2.08	-.45	23.08
Energy/ Resource Consumption	1.33	-.33	1.25	.64	-1.42	-2.83	-.58	-.83	-1.42	1.27	-.18	-.25	1.25	.58	.90	1.20	.64	.40	.83	2.00	4.45
Life-Style	.50	.83	1.00	.64	.75	.42	.58	.92	.83	1.09	.91	.50	.92	.92	.80	1.10	1.00	-.80	1.17	1.64	15.72
Political Roles and Conflicts	.92	-1.67	.67	-.55	-1.17	-2.92	0	0	-.50	1.27	-.70	.42	1.00	.17	-.50	.30	1.09	-1.20	.17	.09	-3.11
Technology Supply System	2.08	-1.67	1.17	-1.27	.50	-.92	1.50	1.50	-.50	1.09	-1.91	2.00	2.00	2.00	.70	.80	1.00	-1.10	1.83	-.91	9.89
Costs, Revenues, Subsidies	-.58	-2.00	.92	-1.18	-1.08	-2.42	0	-.33	-1.42	.64	-1.55	1.17	1.83	1.17	.10	1.20	-.64	-1.20	-.67	-.91	-6.95
Labor	1.08	.33	.17	.55	.50	.08	.58	.75	.58	1.18	.73	1.25	.83	.58	.25	.70	.91	-.10	.25	-1.00	12.18
Existing System Constraints	.22	-1.22	-.11	-.75	-.33	-1.89	.33	0	- 00	-.50	-1.75	.44	.22	-1.00	-1.25	-.29	0	-.86	-1.22	-.67	-11.63
Overall Score	9.54	-3.66	7.73	1.26	-1.92	-12.06	3.82	4.34	-2.68	11.40	-.81	6.61	12.97	8.43	4.50	9.11	7.64	-2.96	6.53	-0.30	75.36
Rank	3	19	6	13	16	20	12	11	17	2	15	8	1	5	10	4	7	18	9	14	X

Figure III-1. OVERALL RATING OF TECHNOLOGY IMPACTS (Panel 3--12 Respondents)

IMPACTS	IPT	TLV	Auto Transporter	Moving Rendezvous	High-Speed Aircraft	SST	Medium CTOL	Small Aircraft	Compound Heli-copter/VTOL	Electric Car	Electric Highway Conventional Car	Improved Bus	Omni-Rental	Multiple Right-of-Way Collection Distribution System	Information System	Intermodal People Containers	Multimodal Terminal	Communications vs. Transportation	TOTAL
Secondary Economic Effects																			
Noise/Air Other Pollution (Congestion)										2.18								2.64	
Regional Development																			
Personal Mobility Access												1.58	1.67		1.73	1.82		2.08	
Energy/ Resource Consumption																		2.00	
Life-Style																		1.64	
Political Roles and Conflicts																			
Technology Supply System	2.08						1.50	1.50				2.00	2.00	2.00				1.83	
Costs, Revenues, Subsidies													1.83						
Labor																			
Existing System Constraints																			
Overall Score	9.54						3.82	4.34		11.40		6.61	12.97	8.43		9.11	7.64	6.53	-0.30
Rank	3						12	11		2		8	1	5		4	7	9	14

Figure III-2. MAJOR BENEFIT AREAS (Panel 3--12 Respondents)

Figure III-3 displays only the major negative impact areas. And clearly, the SST and TLV are judged to pose the most severe impact problems, with intermodal people containers and VTOL following along. The major problem areas impacting these advanced technology modes are the constraints already established in existing systems and a very real concern over the question of capital costs (including financing), potential revenues, and the need for operating subsidies. The importance of the political roles and the political conflicts resulting from attempting to implement the problem technologies was revealed. Interestingly, technological shortcomings as impacts were foreseen in only two major problem systems, the TLV and the electric highway. That the electric auto was perceived as a major benefit, while the electric highway was perceived as a major problem, at first seemed anomalous. The apparent contradiction lies in the belief that a battery-powered auto will be acceptable for ICT on a conventional highway.

In summary, the panel concluded that the major areas of impact for various ICT technologies are almost exclusively in "software" or "soft sciences." These problem areas, dealt with specifically in the following section, are the ones the technologist is least prepared to handle. The following section treats each of the specific technologies for which the panel developed recommendations. The results of the assessment tend to point to a greater need for the representation and active participation of the social scientist in future transportation research and technology.

Software

Institutional Constraints. Potential institutional problems affecting most ICT systems were judged severe, especially for those technologies which were more than incremental improvements to existing systems. This included TLV, SST, electric highway, compound helicopter/VTOL, and several others. The specific impact problem varied from system to system, but the general conclusion emerged that the candidate system could not be implemented if early research into, and resolution of, institutional problems was not undertaken. Specific examples include right-of-way constraints--both ground and air, political resistance from advocates of competing modes, implementation under operational conditions, and regulatory agency constraints.

Public transportation usage will not increase until the door-to-door access/egress problem is resolved. Some panel members feel a demand-responsive, nominal-fare, collection/distribution system is required to shift ICT from auto to other modes. In extreme cases, it is argued that this part of ICT should be provided regardless of original destination location. It should not be assumed that the shift from auto to ICT is necessarily a desirable objective without further study. Most people apparently perceive the private auto on a modern highway as a superior good. Inquiry should be directed into shifting people from

IMPACTS	IPT	TLV	Auto Transporter	Moving Rendezvous	High-Speed Aircraft	SST	Medium CTOL	Small Aircraft	Compound Helicopter/VTOL	Electric Car	Electric Highway	Conventional Car	Improved Bus	Omni-Rental	Multiple Right-of-Way	Collection Distribution System	Information System	Intermodal People Containers	Multimodal Terminal	Communications vs. Transportation	TOTAL
Secondary Economic Effects																					
Noise/Air Other Pollution (Congestion)						-2.33			-1.75												
Regional Development																					
Personal Mobility Access																					
Energy/ Resource Consumption						-2.83															
Life-Style																					
Political Roles and Conflicts		-1.67				-2.92															
Technology Supply System		-1.67									-1.91										
Costs, Revenues, Subsidies		-2.00				-2.42					-1.55										
Labor																					
Existing System Constraints						-1.89					-1.75										
Overall Score		-3.66				-12.06			-2.68		-.81							-2.96			
Rank		19				20			17		15							18			

Figure III-3. MAJOR PROBLEM AREAS (Panel 3--12 Respondents)

the auto to another mode which is perceived to be inferior by the traveler. There may well be valid reasons for the shift, but they should be investigated and documented.

Conversely, the value of the wide distribution of urban and industrial growth through the rural areas of America was questioned by some. There are two questions in this regard. What is the impact of various ICT systems on this distribution of urban activity? Is this wider distribution good or bad? Research should address the first question without making the value judgment of second.

Research should also address the characteristics of a transportation system which encourage or discourage widespread urbanization. Specific characteristics such as service frequency, service volume, geographic diversity, and travel time should be examined. The interaction with intracity transportation is also of importance.

One consumer viewpoint is that the technologist, although claiming to be aware of political or institutional constraints, does not pursue indicated solutions vigorously. At least, the rate of progress appears much too slow to the consumer. It is evident that further information must be made available to the traveling public as to the nature of these so-called political or institutional constraints.

The traveler believes the solution is simple to accomplish, yet the technologist offers political or institutional constraints as the cause for lack of action. It is suggested that the technologist must offer solutions to this class of problems in a more forceful manner.

Fare-Demand Relations. The feasibility of a given transportation technology is dependent upon, among other things, the subsidy required. The subsidy, in turn, is dependent upon the fare structure and projected demand for service. The prediction of fare-demand interactions is difficult in new systems, as well as old systems which are being altered for greater efficiencies or to serve a different market.

It is well known that socioeconomic classes and travel purpose will cause variations in the fare a traveler is willing to pay. It is not so well recognized that travel time and travel comfort will also cause this variation. Inherent in such research will be further study of the value of time or at least the value subjectively placed on time saved by the various classes of travelers.

Research should be initiated to develop the capability to predict this interaction as a function of socioeconomic class, service comfort, travel time, and travel purpose.

The study should include an attempt to determine the basic parameters and their relationship as an initial effort. This should be followed

by development of a model of this interaction process. Such a model would facilitate a variation of the parametric relationships developed in a sensitivity analysis of the process.

Perception and Value of Time. Changing attitudes on the value of time appear to be emerging. The demand for higher speed appears to have topped off.

The perception of the value of time may change dramatically in the next 25 years from today's concepts. There is reason to believe that, as the workweek shortens, the value of time for the business traveler will increase. However, for the private traveler it may decrease. Further, in a related concept, the duration of travel time, as perceived by the traveler may become more significant. A long comfortable ride may be preferable to a shorter uncomfortable ride. Passengers may wish to socialize or spend time reading or working.

It is recommended that research into changes of values and perceptions of time be initiated to provide a base for judging possible basic shifts in the elasticity of demand to speed.

Changes in perceptions of the value of time such that "quickest is not necessarily the best" suggests that system design will need to emphasize comfort and facilities to enable persons to spend their time in pleasant surroundings. Design of terminals, for example, will need to be given much more consideration from the point of view of passenger comfort.

Fears of the Population. Transportation systems of the future should consider and cope effectively with the fears of the population. For example, TLV may well be opposed out of *fear* that it will be noisy. Fear of accidents is a major reason for opposition against widebody jet operations in and out of Osaka Airport. This same fear may well arise in the population along the TLV right-of-way. It was apparent in public reaction to the SST. These types of concerns may be real or imagined. Will some of the population be afraid to ride at high speed on the ground? Will high speed at ground level induce vertigo? Will high-speed travel have an adverse effect on adjacent property values.

Research is recommended into the psychology of both the traveler and the impacted neighbor of any new high-speed intercity transportation system. Education programs must be formulated to cope with such fears.

Labor. The labor issues and impacts have been discussed in at least two broad perspectives: impact on "transportation" labor force and effect on general employment. More specific research is needed on the labor implications of advanced and/or improved transportation system developments. A related impact is that of the need for, and cost

of, training personnel to operate the new technology and to retrain people displaced from obsoleted transportation employment. Displaced professional management must likewise be considered.

The reallocation of a significant portion of the total labor force directly impacted by any major change in the U.S. automobile economy must be fully investigated and planned.

Hardware

Improved Bus Technology. The bus emerges as one transportation mode with the most positive impacts for the future. Further research is required to discover reasons why more people do not use the bus. The inquiry should review institutional restraints preventing bus development (such as wider buses on the Interstate Highway) and public attitudes toward riding buses. Problems relating to bus transportation information systems and the origin-to-destination collection and distribution system are apparently factors. Location, atmosphere, physical condition, and intermodal aspects of bus terminals are related problems.

Tracked Levitated Vehicle. Significant political problems and risks associated with TLV are foreseen. These are partly on a macroscale and partly on a microscale. Will the rest of the country approve TLV in a few corridors in the country considering the enormous expenditures envisioned? How will political problems of implementation in only one corridor be solved? How will local political problems of obtaining new rights-of-way, terminals, tunnels, and access/egress be resolved?

A second issue is considered: the safety of the train and its passengers. High-energy systems are inherently unsafe. Energy storage subsystems present different problems than high kinetic energy. If the system stores energy due to high speed in close proximity to other objects, severe safety problems arise.

A research study of TLV safety problems is recommended due to these energy considerations. The study should be limited to the undesired mishap events related to high speed, close ground proximity, close community proximity, and guideway and control system malfunctions. This study should provide the basic parameters on which to base safety-related engineering design, as well as more detailed safety studies which should be implemented during the engineering design.

The passenger demand for higher speed transportation, on a cumulative basis, has been largely met by technology already available or on the near horizon. The vast majority, 87%, of intercity travelers accept the slow speed of the private auto rather than pay the apparent higher cost of air travel. The driving force for implementation of high-speed transportation via TLV appears to be the technologist.

Improved Auto. Because of the convenience of auto travel--departure and arrival times, door-to-door service--and economy when three or four people travel together, there may be no reduction in intercity car travel despite the fact that cars will be smaller to be more energy efficient.

It is considered impractical to legislate against the use of the auto. Restrictions will have to be much more subtle than direct prohibition. As use of the auto decreases, auto sales, production, and all of the supporting industry decline, creating need for massive employment retraining and new product development.

As cars get smaller, they appear in more adverse relationship to larger trucks and wider buses on the Interstate Highway System.

Recommended are studies into the development of replacement industries for the reduced automobile industry. Further psychological studies are needed to determine how to overcome the larger auto ownership "macho" tendency of the innercity disadvantaged if the improved auto is also a smaller, stripped-down vehicle.

The consumer advocate stressed the need for an educational awareness program to inform the intercity traveler of the total cost of operating his auto, in order to force a more realistic choice of intercity travel options. The bulk of intercity travelers will continue to use the private auto, regardless of new high-speed technology, if the true costs are not fully understood. It is recognized that the automobile of the future will be more efficient and smaller, but it will continue to contribute to environmental and land use problems if it functions as it does today as the principal mode of travel. The heavy demand on space--both in cities and in the country--for moving and storing automobiles may even intensify, further diminishing the prospects for planning cities on a human-scale and improving the urban life-style.

On the other hand, it is argued that, with diminishing highway-user revenues due to a shift to smaller, more fuel-efficient cars, the various states will not receive sufficient funds to improve and maintain the highways. This same comment may be made as an unforeseen impact of the electric highway.

Electric Highway. Resistance will be encountered to installing any electric highway before there is any appreciable demand for the technology because of high initial costs. Car owners will not buy "black boxes" at high cost for their private autos in view of the limited initial usage which will be possible. Each consideration is dependent on the other, and a mechanism for overcoming this inertia is needed.

Energy implications are uncertain in the panel's view.

Concern for safety is both real and imagined. Will there be any physiological effects from traveling in a strong magnetic field? Will there be side effects on livestock, etc., bordering electric highways? Will the electrical field affect electronic control systems, create television or radio frequency interference, affect heart patient pacemakers, cause cataracts? How will driver training be handled? What about car or system accidents and breakdowns? Can disabled cars be cleared off an electric highway. How will users be metered and billed for electric power? Will the public support the installation considering the extremely limited initial usage--a short highway, few users? Will the public accept digging up Interstate Highways to bury cables? How will diverging and converging traffic and guideways be handled?

Multimodal People Pod. These are small vehicles or containers placed on an undercarriage to provide greater origin-destination flexibility because of the small size of the unit; therefore, more communities could be served.

Problems requiring study include: Will people be afraid to get in a pod with strangers? Will people be afraid to travel alone in a pod? How are on-board service and comfort amenities such as food and toilet facilities to be provided? How will on-board traveler security be provided?

How are pods detached from the through carrier at midpoint destinations? Is the purpose of the pod to provide door-to-door service? If so, how will pods be aggregated to destination "X" from multiple departure points on a trunk route?

Collection/Distribution Systems. Experience tends to say the systems approach to this problem is incorrect. Further evaluation is required of the results of efforts to date to demonstrate or evaluate these types of technology. It is recommended that a tailor-made transportation solution be developed for each geographic location, taking advantage of the characteristics of the ICT mode and the *intracity* modes in use in the travel corridors or city-pairs. One specific example of the tailored approach is the mini-bus which runs between an airport terminal and a hotel and which is available on demand.

A strong consumer viewpoint holds that there is a pressing need within each urban area, its suburbs, and its hinterland for a far flung and comprehensive collection and distribution system. It should enable persons to get from home to any other destination within the area--including terminals which would connect with intercity modes--without the use of the private automobile.

Such passengers might have to use several different modes during the trip, but the switch from one to another should be made as convenient as possible.

The system would give mobility to countless thousands of "invisible" persons who now are virtually frozen in place because they have no access to the private automobile at times when they need to move. The social and economic disbenefits of the absence of such a comprehensive collection-distribution system have never been calculated but are thought to be enormous.

Cost is not thought to be the major deterrent to establishment of the system, and it need not be operated by one agency. Some of its parts could be private and profit-making, some would have to be government-owned, and others might be privately operated with government subsidy. It would, however, have to be coordinated and regulated, preferably by the unit of local government which exerts authority over the broadest area.

Included in the system could be all the regular modes of transportation plus paratransit--jitneys, taxis, vans--some of which are not now authorized to operate.

The system also should have a place for owners of private autos who would be willing to operate them as part-time taxis or jitneys in areas where, and at times when, there is too little demand to attract the more traditional modes. An example is the infrequent debarking of a passenger at a typical small flag stop in the middle of the night but still some miles from final destination.

Moving Rendezvous. This concept, as described at a plenary session, raised critical questions:

Why force some modes to relocate their main downtown terminals to remote country locations, requiring the establishment of a "tee" branch? This appears to add to the door-to-door travel problem and eliminates the city center terminal advantage of railroads.

How will the disadvantaged get themselves and luggage into the proper car *after* rendezvous with the trunk vehicle movement in order to be dropped off at the correct destination? Many on-board service personnel are needed to direct and assist passengers. The transfer of handicapped persons from vehicle to vehicle will create considerable technical and social problems. Labor complications with operating unions appear severe: full train crews would be required for each pick-up, drop-off car. What would the excess crews do during the line- or trunk-haul portion of the trip?

Omni-Rental. An innovative car service leasing arrangement is proposed whereby the customer contracts for the use of an automobile--any automobile--for a period of time, say, a year, wherever he may be. He is guaranteed a car (not a specific car), and he can exchange cars at

will. He drives to an ICT terminal, turns in the car to the leasing company, and boards ICT. At destination, he receives another car, etc. The objective is to close the missing door-to-door gap of the plane, train, and bus transportation system. However, there are problem areas.

Does a driver develop pride-of-ownership in a specific car? If the car is constantly exchanged, will he mistreat the car? Will the car require excessive maintenance due to driver carelessness? Will the leasing company be able to sell cars at an adequate price to continue profitable business, a la Hertz and Avis?

Can liability and theft insurance be adequately handled for such a plan?

Existing car rental companies might be expected to offer such plans with improved options.

Multimodal Terminals. The concept of an intercity passenger transportation supermarket is attractive, but implementation requires considerable study. Research needs were identified with this concept.

Will it be possible to force competitors in various modes to accept the principle of a single terminal/ticket/office/baggage-handling/arrival-departure point? Suppose some modes are subsidized or nationalized, while others are free enterprise? What about problems of catering to different socioeconomic groups?

Who will plan and run such a terminal? Who will do traffic engineering to take care of all the private cars, taxis, intracity buses, and light-rail vehicles converging on a *single* multimodal terminal? Who will provide the temporary and long-term parking and where? Can baggage from possibly four modes be successfully handled, interchanged, and sorted? How would ticketing/sales be organized?

Communications vs ICT. The high cost of much of the new technology of ICT may become the driving force which brings about the development of the communications substitute, including voice, high-speed facsimile, slow-scan TV, and closed-circuit live TV with automatic zoom lens and controllable field of view cameras.

Negative impacts may result from rights to privacy being questioned.

Transportation Information Systems. There is a need for transportation systems to enable travelers to utilize present and future modes more effectively.

Means should be developed by which travelers discover alternative ways to move from A to B. Why is it not possible for a traveler to dial one number from any geographical location and receive, with minimal time

delay, a variety of alternative transportation options by which he or she might proceed from location X in city A to location Y in city B? Why should the traveler not be able to receive displays of his options so that he might attempt to optimize his choice in terms of his own optimization parameter, be it time-in-transit, dollar cost, or energy cost?

A great need is perceived for better information systems, particularly multimodal ones (air, bus, and rail).

There are two aspects of the problem: (1) intercity (i.e., for travel from terminal to terminal), and (2) end point (i.e., from terminal into the city or town).

Important points are:

1. Standardization of inquiry and displays so that it is operated, and even looks, the same all over the country.

2. The need for various types of information such as (1) verbal (i.e., person-to-person or at least voice response); (2) maps, routing, timetables, optional modes, fares; (3) signs; and (4) printed leaflets.

Problems are seen to be mostly institutional (jurisdictional) and funding, and the need to cater particularly to the large numbers of infrequent travelers who will require instruction in the use of the system and assistance in the interpretation of responses.

Assigned Panel 4

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Organization of Panel Chairman's Report

Assigned Panel 4

Session 1

This report on Session 1 is divided into four parts: general remarks, comments on principal social and economic issues, comments on background scenarios, and comments on transportation innovations.

General Remarks. Transportation, like energy, is woven into the very fabric of society. It is easy to assume that transportation decisions are central to society, and that society should decide first what transportation it can have and then let the consequences follow from the decision.

This report proceeds from an opposite philosophy. Transportation should be seen as a facilitator of other societal desires (e.g., economic efficiency, environmental quality, social equity), not a determiner. It should be the servant, not the master. Therefore, throughout the discussions, issues such as the kind of a society we want, how we should decide that issue, and where benefits and burdens should lie, emerged frequently. These large issues--which some argued should not be discussed because the scenarios answered them for our purposes--refused to lie hidden. So many in the group felt that we must make these choices explicitly, that the scenario-bound approach failed. Perhaps the scenarios gave materials against which to sharpen thoughts, but the issues were too important to have others assume them away for the participants.

Comments on Principal Social and Economic Issues. Society is made up of many variables, and it would be easy to suggest thousands of issues which are important to significant segments of American society. Time is finite. The following issues appeared frequently during the discussions:

1. Block Time. What is the impact of a given technology on the use of time? How do we believe that people will value their time in the future? What if our guesses are wrong? Are value-of-time perceptions different among people of different social or economic classes? If so, should those differences in perception be honored by class-differentiated transportation modes?

2. Cost. How much will a given technology cost? Will ticket prices have to bear the entire cost? If not, where will the subsidy come from? From other segments of the traveling public? (Who decides?) From the general revenues?

3. Growth. Should community growth be managed explicitly? When considering ICT, the most important aspect of growth is population distribution. How do we decide? Who decides? How are decisions enforced?

4. Transportation Roles. What do we really want from our transportation system? Should ability-to-pay be the allocating device? If not, what other device should be chosen? Are there human needs which technology ignores at its peril, that is, why do people like autos? Why did Picturephones fail?

Comments on Background Scenarios. Some participants challenged either the idea of scenario building or the relevance of such background scenarios to the exercises in which we were engaged this week. Others accepted the background scenarios (or at least held their peace) but suggested that the scenarios needed supplementing.

Those who dislike the scenarios felt that these background scenarios, as defined, had no necessary relation to the choice of transportation technologies to which they were tied. Since a particular set of assumptions concerning the world didn't seem very related to the technologies chosen, these participants doubted whether the background scenarios added to the richness of the deliberations.

Others felt that important issues were ignored by the scenarios:

- There was no consideration of aesthetic issues: what goals do people hold in high esteem (e.g., privacy, community, mobility, roots), and how do these influence transportation desires in each of the four projected worlds?

- What legal or Constitutional constraints limit possibilities within a federal government made up of states with broad reserved powers? Does this split of jurisdiction constrain the possible in ways which should be made explicit?

- How do the scenarios deal with the fact that 87% of our present intercity transportation is now auto? What changes do the scenarios suggest in the values which autos have (privacy, personal choice, cheap perceived cost, speed, convenience, no interface delays)? How are those changes effected? Can the scenarios be realistic if they ignore this issue?

- How does society make its choices? Will this change? Will adversary proceedings dominate? What of the power of administrative agencies vis-a-vis the legislature?

- Within government, how are jurisdictional disputes to be resolved? Among governments? Who decides? What constituencies

do they answer to? Who funds? Who regulates? In whose interests?

- Is there a governmental agency dealing with ground transportation which has the power to decide and carry out programs? Should there be?

- Should government serve as a coordinator of technologies so that systems are developed fully rather than merely as incremental additions to existing systems? If so, does this suggest that entirely new technologies should be the focus of government R&T because they will not have to depend on partly out-of-date infrastructures?

- Should the government serve only as a setter of standards (i.e., like the National Bureau of Standards) and let developments take place within those standards so that duplication would be eliminated? Cost and reliability improvements might result.

- Should the government enter the transportation field at all? Won't private interests do well enough?

- How should (or could) government induce technological change?

- How should regulation be carried out? By freeing the economic system to make decisions? By direct goal-setting? By financial incentives and disincentives? By research and development (a form of financial incentives)? To what purpose do we regulate: equity? maximization of diversity and choice? environmental protection? consumer interests?

Comments on Technological Innovation. Some technologies have been left out which are of interest:

- Consider technologies to increase auto load factors. Consider ride-sharing devices, including better methods of exchange of information.

- Improve information/communication services to assist potential travelers, manage traffic flow patterns, and replace labor.

- Consider electrification or powdered-coal technologies for railroads.

- Consider chemical storage of solar energy.

- Consider all-electric ICT bus.

- Reconsider the low probability given to the communication/transportation trade-off.

Some ideas of a novel kind, might merit an evening's discussion: space shuttle; "Beam me aboard, Scotty"; free transportation for certain classes ("transport-stamps"); quiet, economical helicopters; aerial tramways; and new uses of composite materials.

Session 2

Our deliberations dealt with Scenario IV. As background to the report of this session, the summaries of that Scenario are reproduced below:

> Background Scenario--Emergence of a strong political coalition committed to ambitious social and economic reform...Strict government control of key enterprises and eventual government ownership of many... Major growth in public services... Steadily increasing population oriented to medium-size cities and nucleated metropolitan areas... No-growth economic policy... Considerable relaxation of international tensions... Low capital and moderate resource costs, but with heavy taxation of private resource use... R&D closely focused on national social priorities, yielding significant innovations in energy production and transportation.
>
> Transportation Scenario
>
> > Air: Substantial improvements in CTOL. Improved small aircraft. New airports in medium cities. Lower fares. Slightly higher speeds. Improvements in air traffic controls. Higher frequency service.
> >
> > Fixed Guideway: Emphasis on TLV. AMTRAK substantially reduced but where used, lower fares, somewhat higher speeds, and some improvement in frequency.
> >
> > Bus: Good bus service. Better Vehicles. 75-mph speed limits. Increased frequency.
> >
> > Auto: Electric autos. Highest efficiency in gas autos. Somewhat lower costs. No changes in speeds.
> >
> > Access/Egress: Many fixed guideway transit installations. Lower costs for both transit and auto. Higher speed for transit and substantially more frequent transit service.

Background Comments. The participants found this scenario difficult to believe. Many felt that it would be impossible to pay for all the improvements which were postulated, since the scenario stated that there would be a low rate of capital formation. CTOL development seemed to be the most likely investment contained in the Scenario, since it represented

merely a continuation of existing trends; but even massive investments in that sector might be very difficult to sustain if the many other social investments suggested in the background were also undertaken.

Another inconsistency within the Scenario was that labor costs are stated to be low. This should favor non-capital-intensive modes of transportation, yet there was a strong shift to capital intensive systems. This inconsistency might be explained by assuming that lower labor costs came from increased efficiencies of production and provision of services. But in a no-growth economy, the capital necessary to make investments in improved efficiency would be difficult to generate.

Finally, one pessimistic participant feared that to support the transportation investment assumed by the Scenario, we would have to forego construction of new energy facilities and many other energy options, leaving the country in dire straits when older plants wore out.

The group was attracted by certain features of the Scenario. The fact that a technology must tread lightly upon the environment in order to be acceptable and the fact that flexible, diverse service modes were postulated, were approved as societal goals. A general concern (raised in the context of CTOL research but more broadly applicable) was that existing technologies should continue to serve as laboratories for new, advanced technologies.

Air Mode.

Improved Smaller Aircraft. Generally, this means bringing those improvements now found on larger aircraft to smaller aircraft. Technological changes are relatively minor to accomplish this goal. There may be many societal effects which would arise from shorter range or more personalized air service. But the rapid rise of such service might be constrained by the lower personal income levels posited in the Scenario. Moreover, the fact that aircraft traditionally realize economies only on longer-range flights might limit the cost-effectiveness of the technology.

Improved Conventional Takeoff and Landing Aircraft (CTOL). Generally, the improvements in this technology are under the skin of the craft. From the user's point of view, there are not very many changes in plane or terminal. Different airfoils will permit larger spans. Newer materials (epoxy/fibre composites) will result in lighter weights. Smaller improvements in engine design will result in less noise, better fuel economy and less pollution. Active controls will improve flight characteristics.

On the positive side, the infrastructure for CTOL is already largely in place. The improvements made in airports in the recent past have now made them capable of handling air traffic until the end of the century.

On the negative side, there is no assurance that we will realize improved CTOL. As noted above, capital shortages may hold down investment. Critical here for aircraft is the question of R&D costs. Unless there are substantial improvements in operating costs and unless the risks of a new plane are perceived by airline companies to be low, existing, less efficient planes may impede the introduction of new technology. Employment shifts are another effect: epoxy makers will capture the market instead of aluminum makers. Finally, in an environmentally conscious world, there may be considerable caution about the manufacture and use of new chemicals. Health effects on workers and communities, concern about material stability in ultraviolet light, and concern about leakage into the environment in unexpected ways may impede introduction.

Ground Modes.

Automobiles. Scenario IV tells us that we will have both conventional autos and electric autos. The conventional autos will be far more efficient than those we know today. They will burn different hydrocarbons and will have automated controls and diagnostic devices built into them. They will probably continue to be the dominant form of urban and intercity transportation, particularly in less dense corridors and for family travel.

Battery-driven automobiles are not likely to be a major ICT mode because of the problems they have with range (perhaps only 100 miles with advanced batteries). Possible infrastructure developments, such as service stations for battery exchange, or technological developments, such as quick-charge batteries, may change this picture, but at this moment, it seems unlikely.

There is a possibility that battery autos could be combined with trains (Auto-Train) for an ideal combination of long-haul efficiencies and short-haul convenience, but Scenario IV suggests that rental automobile services will provide this combination.

Electric automobiles of other types are a possibility for ICT. Electric pick-ups in highways, combined with battery storage for off-highway use might follow the introduction of such a system for public transportation. Finally, some induced power system, depending on cables in the highway might develop eventually, although probably outside of our time frame.

Bus. One possibility for an improved bus would be an all-electric bus running off of overhead wires. The bus could have storage batteries so that once it was off the Interstate Highway it could operate the shorter distances necessary to take passengers downtown. The cost to electrify a highway would be about $200,000 per mile. Contact systems are more likely to be adopted because noncontact systems for getting

power to on-board electric motors have ionization problems affecting public health.

Although the vehicles would be clean and quiet, it is uncertain what kind of future makes possible an all-electric transportation system.

Very High-Speed Ground Transportation (VHSGT). Much of the discussion centered on one example of the VHSGT, the tracked levitated vehicle (TLV).

The TLV, which looks much like a high-speed train and has a smooth ride, could reach speeds of 200 to 300 mph, although present speeds are around 150 mph. The higher the speed, the greater the operating costs. TLVs need carefully constructed and protected guideways; noise may be a problem particularly at high speeds. The guideway costs are less than conventional railroad beds:

Conventional railroads	$10 million to $11 million/mile
Present TLV guideways	$10 million to $11 million/mile
Improved TLV guideways	$ 5 million to $5.5 million/mile
TLV guideways on-grade in level areas	$ 1 million/mile

Guideway costs are about 60% to 80% of the cost of the system; therefore, a research priority should be holding those costs down.

In general, the participants had misgivings about the possibilities of TLV systems. Assuming that TLVs are suitable only for very high-density, heavily traveled markets, perhaps only 800 miles of TLV guideway would make economic sense for the entire country. That might cost $6 billion to $12 billion; it is unlikely that Congress would appropriate that amount of money for only a few markets. The energy efficiencies of the vehicles were questioned. The need for a very high-density market seemed to present the greatest risks, since unless that market is assured, the system will be prohibitively expensive.

A disagreement arose about the use of TLV technology for both freight and passengers. Some with technological training felt that it was usable only for passengers and light freight; others with technological training felt that a combined mode (including Auto-Trains) was the only way in which such vehicles could be assured of sufficient revenue to justify their fixed costs.

Sessions 3 and 4

Methodology. The group first listed 11 technologies as possibilities to discuss in more detail. Because a discussion of even 11 technologies would be irritatingly superficial, the group decided to select some 'filters' to pass the list through in order to select no more than three technologies. The filters mentioned were:

1. Choose technologies which give a good balance of range, cost, and area served.

2. Choose technologies which are likely to have a high impact on society and on the physical environment.

3. Choose technologies which are going to move many people rather than technologies which have fairly limited markets.

4. Choose a good mix of modes so that intermodal cross-impacts can be made intelligently.

On the basis of these filters, three technologies were selected for full discussion:

Very high-speed ground transportation systems

Improved conventional automobiles

Conventional takeoff and landing aircraft

To serve as a check list, the group quickly listed 25 impacts or classes of impacts which seemed to be possibly important in looking at each technology:

1. Time use

2. Impacts on spatial form

3. Cost, including capital and operating cost, fare structure, and subsidies

4. Transportation roles

5. Energy impacts

6. Environmental impacts

7. Safety

8. Reliability

9. Social equity

10. Consumer interests and how they are expressed in system design and operation

11. Labor, including job choice and employment patterns

12. Elected officials and their role

13. Life- and play-styles

14. Impacts on the nation's economic structure, including levels of competition

15. Changes in patterns of capital investment

16. Who is the user and why is he making the trip

17. Political reality and whose interests are being served

18. Comprehensiveness of government regulation

19. Rule-making or regulations by nongovernmental institutions such as financial or insurance companies

20. Balance of payments

21. Impact of changes on manufacturers

22. National security

23. Impact on the service economy

24. Resource intensity--materials, managerial skills, etc.

25. Aesthetic--human psychological acceptance

Described below are observations on each of the three technologies which we discussed.

Very High-Speed Transportation Systems--TLV. A good deal of the discussion centered around the effect the technology would have on land use patterns and the secondary effects which those land use patterns might have on the finances and social health of the central city. The discussion assumed that there would be "rendezvous" systems which would permit access to the line-haul guideway so that the main vehicle did not need to make any stops. A further assumption was that many of those rendezvous stations would be in the suburbs of central cities served by the TLV. These assumptions seemed reasonable: The political acceptability of the system depends on many people benefiting from it; if it

passed through many jurisdictions which were denied access, citizens of those jurisdictions might become opponents of the system. The concept of many rendezvous stations also seemed critical to the financial health of the system. TLVs depend on massive ridership to be cost-effective. A number of participants pointed out the assistance that suburban stations have been to the Metroliner and thought that experience would be followed for TLV.

If the assumptions listed in the first paragraph are correct, TLVs might have a potential for job commuting. Because of the speed and range of the vehicles, nucleated cities would be one possible result. Another result might be that medium-sized cities which have fairly independent economies today might find themselves turned into bedroom communities as their business and talent were drained by the metropolitan area served by the TLV.

If the TLV turns out to be as powerful a land use determiner as suggested, its power might be turned around and station placement might become one method of channeling land use development. But this seems unlikely. The technology is so hungry for ridership that potential markets probably would not be turned away for other, more diffuse social goals.

Nucleation of cities, or the use of TLV for commuting has both positive and negative effects. Businesses within the center city are able to serve much wider areas, and specialized centers such as educational facilities, libraries, and hospitals can become more expert or specialized since good transportation makes their service areas bigger. On the other hand, conventional wisdom suggests that commuters are bad for the central city because they make demands on space and service but do not contribute their share to the financing, life, or governance of the city. Some methods of transfer payments should be considered in order to compensate cities impacted by TLVs: revenue sharing, direct grants, or commuter taxes.

Another characteristic of the TLV system is that a determination must be made to build it, because it is not an incremental system. One of the important ways this generalization is true is the necessity for raising large amounts of capital over a limited time. Systems must be invented which permit governments to share equally in the regional benefits and local disbenefits of the TLV. The capital requirements (and the volume of the traffic necessary to make the technology economically feasible) also suggest that it may be inherently anticompetitive. If government financing is the method chosen to raise capital--which seems inevitable--there is a high probability that government might try to protect its investment in the TLV by restricting competition in competing modes along the corridor. Thus, the effect of the TLV might be to restrict choices for the area served, rather than to open up an additional new mode.

Management of the system is yet another difficult task for government. Regional benefits and central city benefits must both be considered,

yet no existing mechanism fully treats the equity trade-offs. Federal preemption is the most likely method for these decisions to be made; yet federal preemption overrides local desires. Other possible (though flawed) methods for regional governance of the TLV system are regional compacts, a system of local permits coordinated through state or regional standards, or regional commissions. Whatever system is chosen, it must be sensitive to the issues of involuntary transfers of money, energy, and people that may come about as a result of building and operating the system.

Finally, the labor effects of the TLV are important. It may have more automation which would increase labor productivity. But if it displaces other modes (either because it out-competes them on price and service or because government protects the TLV), the labor-intensive modes it replaces may put many out of work.

Moreover, we are not sure about the attitude toward work which will prevail in the future. Although international competition may keep American labor-productivity high, some participants noted that we have seen changes in the work ethic in this country which may increase the number of workers for the same output.

A number of other less developed ideas concerning the impact of the TLV were put forward:

- The TLV competes with the CTOL and the quiet vertical/short takeoff and landing aircraft (V/STOL); the introduction of one technology might preclude the development of the other.

- In energy consumption, the TLV is comparable with the CTOL, but has the advantage of using centrally generated electricity In principle, pollution control devices are easier to put on a single power plant than on hundreds of vehicles.

- Compared to the CTOL, the TLV has the disadvantage that it is a new technology, and it is not incremental.

- The TLV will certainly have noise problems which must be dealt with if it is to be used in populated areas.

- As a means of cutting the costs of using the guideways, perhap they should be designed for off-peak hours use by buses, trucks, or trains.

As a footnote to the discussion of TLVs, one participant gave details of a proposed TLV system now under consideration to run between Dallas and Fort Worth and the airport. The guideway length would be 35 miles. The proposed management system for the system would be designed like a turnpike commission. The funding sought would be 80% federal and 20% nonfederal. The system might include as many as 16 stops. Fare for a one-way trip along the entire length of the system might be around

$5.00. The range of costs proposed by participants for this system varied from a low of $450,000,000 to a high of $1,000,000,000.

Improved Conventional Automobiles. Certain assumptions were made concerning the new auto. It would be nonpolluting and would use far less fuel (perhaps 50% of today's consumption per vehicle-mile). The participants were unable to agree whether the aggregate consumption of energy for autos would rise or fall, nor was agreement possible concerning the amount of energy that would be available. Therefore, it was very difficult to make any sure assumptions concerning the number of vehicle-miles traveled or the number of automobiles in the total national fleet.

It seemed likely that automobiles would be relatively more expensive; this is a certainty unless the impact of rising labor costs on the manufacture of automobiles can be solved by further automation. Higher first costs might bring some of these effects:

- New cars would become a prerogative of the wealthier classes even more than they are today.
- If the equity problems of the need for an automobile and the inability of some to pay for it bother society, then income redistribution by direct means is a better way to solve the problem than a subsidy system such as auto-stamps.
- The size of cars will decrease so that the same dollar expenditure will buy less.
- Age of car will become a means of differentiating the driver's social class.
- Systems will arise so that cars or (more likely) parts of cars can be recycled so that rebuilt or junked car parts will play a bigger part in the repair market.
- Recycling systems must be developed, and that will take regulation or incentives to the car manufacturer. If materials in the car cross-contaminate one another, recycling is hard; if components of the car are valuable and fairly easy to recycle for their materials, then recycling is more likely to happen.
- There may be a strong movement for greatly extended life for cars, with legal liabilities attached to manufacturers who build short-lived cars.
- Car repair shops will be under pressure, perhaps enforced by legislation, to provide quality service.

- Cars may be designed so that more people can make minor repairs at home.

- Diagnostic systems in autos will improve so that major breakdowns can be avoided.

- Highway safety and insurance programs are likely to become more important to protect the expensive investment.

- The current worry about the safety of smaller cars will become less important as the fleet becomes all smaller. The problem of buses and trucks crashing with autos may be solved at ICT distances by separate lanes; it is harder to imagine an urban solution to the problem.

- Auto inspection will become more popular, including nonrepair diagnostic shops.

On the environmental side, if we assume that the automobile becomes environmentally benign as to residuals, an important question remains how we can export that American technology to other countries so that we may benefit from their cleaner air as they benefit from ours.

Finally, some words on the intermodal effects. A better urban transit system might have the effect of increasing the use of the automobile for ICT. People will not need to have a commuting car and may be better able to afford a larger car for ICT. If this happens, it could harm the market for TLV. Conversely, the presence of cars in the suburbs may enhance the load factor for line-haul systems since the private car is an excellent method of moving people from diverse origins to the terminal where the line-haul carrier is available.

Conventional Takeoff and Landing Aircraft (CTOL). One observer asked what would be the effect of good, inexpensive CTOL service on our medium-sized cities. Land use changes might be one effect. Because of the point-to-point nature of air transportation, widely nucleated cities within the range of the hub city might result. This might permit more choice of diversity of life-styles in each of the satellite cities, and specialized services could cover larger areas. On the minus side, cheap flights might permit many people who now exhibit behavior problems on other transport modes to shift themselves and their problems to the air mode. Frequent, low-cost service to cities would bring the disbenefits of noise to those areas. In choosing the CTOL mode over a train or a TLV, "noise hot spots" (airports) would be gained, while "noise corridors" (guideways) would be avoided. The noise problem, or more accurately attempts to avoid the problem, might cause problems: land use and access/egress problems and delays seem to follow from the moving of airports further from the city. Federal preemption of local controls on noise might become more strict so that accommodations such

as that worked out in Washington, D.C., concerning flight times and paths around National Airport would be impossible.

One of the ways in which benefits of improved CTOL could be made more general would be deregulation of the airlines. If this happened, it is likely that the trunk carriers would go through a difficult period, perhaps ending up with only five major carriers serving the markets. Shorter, presently less-profitable runs would fall to the smaller companies. Because competition would be on price as well as on service and frequency, deregulation might permit higher load factors. (A disbenefit of higher load factors is that businessmen who are accustomed to walking onto almost any plane at the last minute could no longer be guaranteed a seat. A fare structure which penalized late reservations might help solve this problem.) A political liability of deregulation will be that remaining carriers have higher profits; these higher profits could be turned to R&D, relieving the government of the burden of supporting R&D. In any case, increased profits will be applied to needed capital investments, and it should be understood that such profits are necessary.

There are advantages, whether under a regulated or nonregulated scheme, for intermodal companies with intermodal terminals. Investors might be more confident in investing in full transportation companies since risks would be spread. If regulation continues, regulation of a multimodal system would be difficult, as the national experience at attempting to regulate AT&T suggests.

The predicted growth in pleasure travel on CTOLs is an interesting development. Personal/nonbusiness trips are now over 50% of the market and by 2000, they should predominate. It is interesting to note that presently airline systems are designed to serve the business traveler; will that change as the market shifts? Classes of service may tend to be less differentiated so that first-class travel will be offered on only a few routes. More pleasure trips may permit greater use of the fleet, since charters can fill up aircraft at off-peak times.

Other ideas which were suggested as impacts included:

- The proper range for trunk carriers will be seen to be over 200 to 300 miles. They will drop out of the shorter flights.
- A 900-seat airplane will cause access problems for the hub cities, which will need assistance in the collecting network to feed such jumbos.
- Air may become more widely used by all classes, bringing with it the problems of social class differences.
- Rail passenger transportation may not survive air competition.

- If alternative methods of travel diminish, the system as a whole will be less robust.

- Government R&D in improving the CTOL might be one method for re-employing engineers.

Session 5

Opening Questions. There was considerable confusion and uncertainty within the group concerning the directions which were most profitable to follow during the final session. Turning the reports of the Wednesday sessions into research questions didn't seem difficult; therefore it seemed to be a waste of time for this expensively convened group to do it. Nor did further work with the technologies which we had already covered seem necessary. The group decided that since we had already received specific approval of what we had been doing from DOT and NASA oversight team members, we would pick two more technologies and try to look at their social impacts. This report deals with the group's look at (1) management and traveler information systems and (2) automated highways for bus and automobile.

Management/Traveler Information Systems. We assumed that a technology could provide two services:

- Potential travelers could receive detailed information from a single reliable source concerning travel options available from a given origin to a given destination, including all modes, their costs, and the time they would take.

- Carriers of all kinds would be able to use an information system to increase system efficiencies, increase load factors, and cut costs.

On the provision of passenger information (a kind of "automated travel agent"), we were concerned and uncertain how such a system should be organized. Would government run it? If it were truly able to create efficiencies, why wouldn't the transportation companies band together to provide it? Later, other companies could join the system by buying in so that their modes and routes would be included. This would give a less desirable system, since the traveler would not have complete information. Moreover, it would be hard to find a company to represent certain modes such as bicycles or even the private car. Another organizational method would be to allow ICT companies to come together into a few intermodal companies, so that a call to all of them (say three to five) would give all the options.

One interesting result of such a system is that it might allow demand schedules for intercity transportation. When enough people asked for a

takeoff or landing (or whatever is appropriate) during a certain time block, it would be arranged and they would be notified. This might create labor problems because of uncertainties among workers on when their services were required. On the other hand, peak travel pricing might be introduced to even out the schedule. One advantage of the information system--that it helps people who don't travel because they think it is too complex--would be lost if schedules became too flexible so that certainty was lost.

Two other thoughts on the system were suggested: first, it would be possible to give people information concerning events (sales, rock concerts, etc.) at their proposed destination. Second, there must be some arrangement so that all bias or appearance of bias in the system is avoided; companies and travelers must both be able to trust the system, and economic incentives (whether legal or illegal) to information-providers must be guarded against.

Dual-Mode Transportation Systems. The dual-mode system was conceived of quite generally, although a number of examples were given: very high-speed bus, automated cars, automated highways, and other systems not yet invented.

A number of possible impacts were considered. If the system is electric, there might be a peaking problem for the system as a whole. In New York, though, the contribution of the subway system to the power peak is small. It may be possible to solve this problem in some manner such as on-site, dedicated, generating facilities of an innovative type or peak pricing for use of the highway.

The fact that the driver need not drive on such a system suggested a number of impacts:

- You could put a stove and a bed in it which drew power from the track power source. This would permit driving across country without stopping; roadside business might be harmed, although people might also decide to stop more frequently because they had fewer diversions.

- A telephone in the car would permit better scheduling of events at intermediate or arrival points, including hotels, special events, meals, etc.

- A television in the car, which seems virtually certain, suggests that national cable television companies will grow up. Would they be networks or new companies?

- If people aren't driving, will they want to drink or smoke pot? Does that cause safety problems when the car is no longer under automatic control? And if cars are close together for long distances, is there a possibility that people will take pot shots at one another?

Will the automated car take away the love affair that people have with their cars, since it will be like sitting in your chair and driving will have no special appeal. How will people find the pleasures and status which cars now give them?

Will people become accustomed to thinking that cars travel very fast, so that when they pull the car off the highway, they will want to drive too fast? If so, will towns become congested? Will they have to widen streets and increase speed limits?

What of land use? Larger, regional shopping centers will be possible, with the smaller centers being hurt. Other thoughts concerning the effects of the technology are:

- How will people conceive of the system? Will it be a right? Or will people pay? Will access be denied to some or will it be like a public utility?

- We will need very high-speed rescue and emergency capability so that stalled vehicles do not tie up traffic.

- Vehicles on the system will have to be reliable and in good condition. Both factors will increase the cost of having a car. Auto diagnostic equipment may check the condition of the car before it is let on the highway.

- If the system is fragile, it will need more security guards. Guards may be needed to protect travelers from people shooting or throwing rocks.

- Police work will be easier since long-range getaways will be more difficult. It will be possible to check electronically license plates of all cars on the system and look for scofflaws.

- Billboards will not be able to be read.

The system will be a major land use and public works project. For a complex system, it is unlikely that the median strip of existing roads will work. Therefore, environmental effects of such massive construction must be considered.

Conclusion. The participants in Panel 4 want to put in writing their pleasure at seeing DOT and NASA working together as a team on the nation's transportation problems. We find this an encouraging sign.

IV. REPORTS OF SPECIAL TOPIC SESSIONS

Introduction

Special topic sessions provided a forum for the discussion of intercity transportation issues and impacts that might not otherwise have been addressed at the Workshop. The sessions were organized and conducted by study participants.

This chapter contains reports prepared by the discussion leaders of five sessions; they cover a diverse set of topics:

- Access/egress
- Government roles in research and technology
- Transportation for the disadvantaged
- Energy options
- Regulation/deregulation

Attendance at the two- or three-hour long sessions ranged from five to fifteen study participants.

ACCESS/EGRESS/TERMINALS/INTERMODAL TRANSFER AND RELATED GOVERNMENT ROLES

Discussion Leaders: Charles Overby and Bob Best

This session was not conducted as a consensus session. Rather it was carried out so as to seek for issues, trends, patterns, and "surprises" as perceived by individuals in interaction within the dynamics of a group process.

Introductory Remarks

An assessment of intercity passenger transportation cannot ignore as part of its concern the question of how effectively persons (a) get from offices, hotels, and homes to appropriate terminals; (b) execute modal transfers; and (c) proceed from destination terminals to business or residential end points.

Part of the dilemma for intercity transportation planners is beautifully illustrated in a little vignette called "Passenger Pigeon--You Can't Hardly Get There from Here,"[1] where a 397-mile journey is documented in time. The 25-mile trip from home to terminal to a seat on the airplane averages 12.2 mph. Intercity air travel proceeds at 347 mph. The 25-mile trip from airplane seat to a destination hotel room averages 17.7 mph. If an objective of transportation planners is to reduce the total time in transit, the above vignette helps to focus our attention on the slow access and egress portions of a trip.

Several of the issue papers for this technology assessment address various facets of the collector-terminal-distribution problem. Illustrative of these are the following: Garrison[2] deals with several aspects of it. Whorf and White[3] comment:

> "One particular intransigent problem which is the subject of general traveler concern is the transportation interface, the major source of the transportation system inefficiency. The specifics include inconvenient or nonexisting parking facilities around airports and train stations, slow or intermittent service on ground carriers from airport to downtown areas, substandard low-security terminals at interfaces between air and rail, or rail and bus transport systems."

Horonjeff, in discussing the federal role in the "airside" vs the "landside" of airport development concludes that major airside developments have taken place in the past 20 years but that ". . . the federal government has done very little in the way of R and D on the landside of the airport with the possible exception of highway access."

Access, egress, and terminal considerations are touched upon by authors of several other issue papers with an overall focus on air travel. Notably absent from the entire collection of pre-Workshop technology assessment materials is any very perceptive focus on these issues for the non-air traveler such as bus.

Participant Discussion

Discussion involved many descriptions of "horror stories" based on personal experience in achieving access, use of terminals, intermodal transfers, and egress to points of final destination. Discussion of these experiences led to the identification of many problem/possibility areas where technological and/or social inventiveness might be needed to improve our intercity transportation system. If nothing else, this discussion helped to focus on several facets which may need further exploration. Illustrative of these "horror stories" are the following:

Stop The Bus, I Want to Get Off!--Sorry! Major intercity bus companies provide service to Chicago from such places as Rockford, Illinois; Milwaukee, Wisconsin; and hosts of small communities to the north and west of Chicago. In doing so, they pass right by O'Hare International Airport each day with many buses. These buses are not permitted to pick up or discharge passengers at O'Hare. Service to and from O'Hare is the exclusive right of a single bus company. Persons who might choose to use an intercity bus to articulate with a flight to or from O'Hare must thus travel into the central city, transfer to the exclusive bus (probably in a different terminal), or use cab or limousine service back to the airport. Is this system designed as if the transportation needs of people mattered, or is it created on the basis of other criteria? What kinds of technical and institutional problems need to be investigated, and what kinds of possibilities might exist for new arrangements to improve intermodal transfer in instances such as the above? What are the governmental connections in this system--local, state, and federal--and what should they be?

How Do I Get from Union Station to Dulles Airport? The intercity terminal situation in Washington, D.C., was outlined. There are several modal terminals to and from which persons move within the metropolitan area. Unfortunately, there is, at best, limited articulation between these separate facilities for bus, rail, and air modes and between intracity systems and intercity terminals. Pro and con discussion of multimodal terminals and other means of achieving better connectedness between terminals ensued but reached little conclusion other than that the technology and institutional hurdles associated with changes in this area need to be studied. Combined facilities complicate access and egress difficulties due to

concentration effects; and yet in trade-off fashion, perhaps it simplifies the transfer process for travelers. Combined facilities of a lesser scale (e.g., all intercity bus lines in one terminal or intercity bus with rail or air) would enhance modal transfer as outlined in the O'Hare case cited earlier. Bus terminals are privately financed, and as long as these arrangements are profitable, why should joint ventures between competing companies or modes be considered? Generally, suggestions for multimodal terminals generate little enthusiasm from existing institutions. Is it necessary to change the milieu such that institutional enthusiasm is this area is stimulated? One participant, strongly arguing that the present system works beautifully, suggested it would be improved still more if deregulation took place such that access-egress transportation were placed on a "free entry" basis. If "free entry" were introduced (assuming it was possible to do so) what would be the consequences for various impacted groups and persons? How would "equity" as a social consideration fare under a system of "free entry"?

Where Can I Get the Big Picture? One participant outlined the difficulty faced by an intercity traveler if he or she truly wished to explore and evaluate all alternative transportation options available to him or her in moving from city A to city B. Obtaining such information during normal working hours requires telephone calls to a travel agency (primarily air transportation), possibly more than one bus company, AMTRAK, various auto rental companies, airplane rental, air taxi and air charter service, etc. This information is much more difficult to obtain during nonworking hours. These concerns lead to questions as to the technical and institutional feasibility and desirability of creating improved transportation information systems. With such systems persons might more easily learn of their transportation alternatives and attempt to optimize in terms of their own time, dollar, or other needs or criteria.

Related to the above, another participant suggested that there was need for better publicity and information on the availability of small commuter airline flights that travel directly to and from smaller airports. Such flights might well place a person closer to his final destination than had he tried to travel to and from major terminals. This does not mean transferring, but rather, selecting a different flight (e.g., instead of Philadelphia to Providence, Rhode Island, take Philadelphia to New London, Connecticut), if the total origin-destination time is less. Many passengers do not even know that there are direct flights to small airports that do not require use of major airports. Does this development of small commuter and air taxi operations represent a significant trend? If so, what impacts might be expected in terms of access, egress, and terminal facility systems? Are intrastate and interstate commuter and air taxi operations significantly different because of different regulatory practices? Can and should new regulatory inventions be created?

But the Sign Said to Call You if I Got Lost!! Another person described his hassled experience in attempting to follow signs and posted instructions which were supposed to assist him in exiting a major New York City airport and finding his way to downtown Manhattan via public transportation. This "horror story" was productive of a host of insights as to another dimension of traveler information needs. Persons need to be provided with adequate information which they can clearly understand, so that they can negotiate their way through the terminal (a) to another bus, train, or plane; (b) to a different terminal; or (c) to a final destination via alternative forms of ground transportation. We should also include the need for clear and adequate information as to transport options from point of origin to the terminal. Information can be received by persons over a variety of sensory modalities and with various forms of technological and human assistance.

Auditory and visual modes are the most commonly used but attention might be given to other modes with special consideration for the sensory/perceptual problems of some handicapped, elderly, young, and educationally disadvantaged persons. Display options can range from signs and pictures to brochures to passive and/or active cathode ray tube (television) to information booths manned by persons. What kinds of traveler information displays and systems presently exist? How effectively can persons use the information in its present configurations? What kinds of creative combinations of people, hardware, and software might be feasible, economically and institutionally, so as to enable travelers to negotiate terminals and access-egress systems more effectively?

Terminals, because of the methods of financing and ownership characteristics, lack uniformity in passenger information systems. Would it be desirable to develop uniform displays, signs, etc., such as has been done for Interstate Highway driver information needs? If uniformity should be a desirable characteristic, how should it be achieved in view of present institutional and economic factors associated with terminals and with different transportation modes?

Airport Access-Egress Cleveland Style? A discussion of the Cleveland experience with a fixed rail link from the urban center to Cleveland Hopkins International Airport led to debate as to whether or not intercity transportation planners could have much impact on the development of collector-distribution systems which for most major terminals lie in urban territory. The collector-distribution problem for intercity transport is a relatively small part of the headache for urban transportation planners; therefore, their driving function will be intracity urban transport needs and not access-egress for a relatively small segment of "elite" who need to get to and from airports. A hypothesis was introduced by one participant to the effect that--"Nothing that intercity transportation planners do can affect the access-egress portion of intercity travel." There was no serious refutation of this hypothesis; however, it was

pointed out that intercity transport planners should find ways to articulate with urban transport planners so as to satisfy access-egress needs as urban mass transport takes off. If contemporary political and economic winds favor the development of urban mass transportation systems, and since intercity transport access-egress lies in the jurisdictional domain of urban planners, it behooves intercity planners to find ways to interact with urban planners so that access-egress problems are addressed in the process of developing urban mass transit. Unfortunately, there was no urban planner in this special session to express his view of all of this. It is conceivable that without considerable effort by someone with a larger systems point of view, the problem of access-egress could drop through some institutional cracks with neither the intercity or urban transport planners doing much about it.

Institutional Relationships. In concluding this review of the highlights of participant discussion in this special session, it appears that institutional and economic constraints and criteria are of more significance than technology in determining the present patterns and future development of intercity transport access-egress-terminal systems. If change is to be introduced, we will need to do some "social inventing" or "institutional engineering." Considerations in this area are very complex, involving legislative and regulatory activity by a multiplicity of levels of government with unclear areas of jurisdiction. These observations suggest a need to study and more clearly explore this institutional-economic domain as a prerequisite to creative future system planning.

Some Brief Observations, Questions, and Considerations

No priority is implied in the order of listing.

1. If capital constraints do limit, in the next 20 to 25 years, the amount of major new capital-intensive intercity transportation development, it may well be that focus in this period will be on improving the efficiency, effectiveness, and comfort of presently existing modes. Many improvements in access-egress and terminal systems can be made to achieve these objectives of efficiency, effectiveness, and comfort without massive capital outlays.

2. Institutional relationships across various levels of government and the private sector need study as a prerequisite to the introduction of changes and improvements mentioned in item 1 above.

3. How are the financial support mechanisms for airports and other terminals related to access-egress and terminal design and operation? What would happen at Los Angeles International Airport,

for example, if good public mass transport cut in half the need for travelers to drive to and park at this airport? How important is airport parking as a source of airport revenue?

4. How can intercity transport planners ride the crest of urban transport development so as to achieve better access-egress?

5. Some possible technical improvement opportunities for consideration and study are:

   a. Mobile lounge concepts from central points (downtown) directly to the vehicle for intercity movement. Difficult to identify "central points" because of dispersed origins and destinations.

   b. Better urban transit operations and equipment (with baggage facilities) to service intercity transfer points. Difficult to achieve due to comparatively low demand.

   c. Remote parking with effective people/baggage movement to terminal (or to vehicle with onboard check-in). Technology now available with the exception of on-board check-in.

   d. Multiple remote terminals with full check-in and segregation by trip, with effective quick transfer to vehicle at a central facility for intercity movement. Remote terminals could serve all modes and provide for easier modal transfer.

6. Information needs and effective communication to the traveler, especially the inexperienced traveler who is growing in numbers, appears to be a significant problem.

   a. Travelers need better access to information about mode options and alternatives within modes so as to enable optimization in terms of his or her needs. Suggests need for transportation information systems research, design, and demonstration.

   b. Travelers in negotiating the access-egress portions of a trip and in intra- and interterminal movements need better guidance, displays and directions. Suggests a need to research, design, and demonstrate improved communications for these aspects of intercity travel--all modes. Special attention needs to be directed here to the requirements of travel-disadvantaged persons.

   c. Information booths (e.g., kiosk-type travel centers in all modal terminals and at remote passenger collection points if coupled with reasonable movement opportunities to and from intercity terminals) could substitute for multiple satellite terminals.

d. Governmental involvement in and relation to the private sector needs to be investigated in the establishment of transportation information systems.

7. Will "free entry" enhance access-egress for travelers? What kinds of requirements for terminal design are implicit in "free entry"? What are the "equity" consequences of "free entry"? Could more experiments in this area be implemented and tracked so that generalizations might result? How formidable are institutional and economic factors herein, and how are they related across various levels of governments?

8. Do developments in commuter airlines and air taxi service represent a significant trend with impact on access-egress and terminal design and operation? If these do represent significant trends, how might traveler convenience be enhanced through improvements in operating and passenger information systems.

9. There is some suggestion that increasing numbers of travelers (nonbusiness) in the future may not view travel time (its minimization) as the most important variable. It may be that more leisurely and comfortable travel (improved physical, psychological, and social amenities) will be more highly valued than minimized time en route. If this is a trend, what are the implications for intercity vehicles and importantly for terminal design. Could it be possible to have bus or multimodal terminals with comfortable motel and lounge facilities in safe and pleasant surroundings such that it would actually be an enjoyable experience to wait between connections? How would such facilities be supported? Should some level of government play a role in the creation and operation of these facilities?

10. Should additional federal effort be spent on landside development of air terminals? What kinds of projects should be undertaken? Should government funding flow to bus terminals to enhance this mode of travel so heavily used by the poor?

11. Would consolidated bus terminals with good passenger information systems lead to more competition and result in improved passenger service en route and in terminals?

12. What are the attitudes and responses of owners and operators of intercity transportation terminals to governmental intervention in their operations?

13. Is increased citizen participation a trend in intercity transportation planning and decision-making? How can passenger input and expectation be more effectively factored into future system designs?

14. Should passenger information systems have a labor intensive interface with the consumer? Who pays the cost?

15. What kinds of special consideration need be given to the needs of elderly and handicapped and to the young in access-egress and terminal system design?

16. Many of the questions and comments above are suggestive of needed research, design, development, demonstration, and implementation studies relative to access-egress, terminal systems. Important considerations in most of these studies will be the institutional and economic realities and government involvement at all levels.

17. Assumed in all of the above is the value judgment that unfettered and comfortable movement of people as they choose to travel is a psychological and social good. A different basic value premise would lead to different questions, observations, and comments.

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2. William Garrison. "Current and Future Forms of Intercity Passenger Transportation," *Technical Report No. 1.* NASA-DOT Technology Assessment of Intercity Transportation Systems. (See Volume 2.)

3. Robert P. Whorf and William White. "Social Impacts on Intercity Transportation," *Technical Report No. 1.* NASA-DOT Technology Assessment of Intercity Transportation Systems. (See Volume 2.)

4. Robert Horonjeff. "Airports," *Technical Report No. 6.* NASA-DOT Technology Assessment of Intercity Transportation Systems. (See Volume 3.)

The Role of the Government in Research and Technology

Discussion Leader: G. J. Schott

This meeting produced widely differing viewpoints. This report gives a brief look at the perceived differences.

First, the semantics of innovation were discussed. Basic research and invention are at the root of the process of innovation. Subsequently, work is done on more practical aspects of the innovative concept. Further down the line come the development efforts which are associated with products, and the interplay between marketing, engineering, and production. This finally leads to market introduction of the new idea.

In the meeting, there may have been consensus on two points only. First, the government should not play a role in the development phase of the process, if development connotes product development. Second, there seemed to be general acceptance of the idea that the government has some role in R&T.

With respect to R&T, the following viewpoints were argued.

1. The government should become more interested in the stages from development to market introduction. Too many inventions are sitting on the shelf and are not getting a chance to be applied. It was argued that, e.g., in the railroad industry most purchasing is done along traditional lines. The government could help to develop truly objective purchase specifications which would open up the bidding to new companies. The National Bureau of Standards (NBS) could perhaps ensure the objectiveness of the specifications. The railroads would guarantee to use the specifications henceforth when purchasing new equipment. The government, DOT in this case, would have aggregated a new market sufficiently large for new suppliers to be interested in and compete for. It was stated that this did not mean financial involvement in the development program. This mode of operation by the government would moreover reduce the stream of contracts aimed at research for research's sake, since the government would be better guided by the world's real needs.

2. A second point of view held that the government should specifically do the basic long-range research. There was mention of a need for a clearer understanding by the government of real-world economics so that uneconomic new ideas would be recognized as such, and either be made economically attractive or dropped.

3. A third viewpoint is that of the conservative wing of the Office of Management and Budget (OMB) which has had the upper hand for several years now. This viewpoint wants the government only to be involved in basic research and only to a small dollar value. The work should not be in an application area unless it is clear that there is a

real, necessary commercial application. And if there is, then industry should either pay for the government work done or do it themselves.

The counterargument against this viewpoint holds that industry cannot afford to spend funds on social-benefit R&T (e.g., noise, pollution, etc.). Industry and the military must primarily be concerned with near-term results and cannot afford long-term R&T. No *one* company can afford some of the more costly facilities and research, while on the other hand, antitrust laws preclude joint activity. Then there are other aspects such as exports, jobs, etc., which make a quality product a national concern. To this last argument OMB then responds with the question: "How come U.S. companies are sharing our technological goodies with foreign countries?"

Transportation for the Disadvantaged

Discussion Leader: Charles Overby
Scribe: Juanita Green

This session was not conducted as a consensus session. Rather, it was carried out so as to seek for issues, trends, patterns, and "surprises" as perceived by individuals in interaction within the dynamics of a group process.

Definition and Magnitudes of the Problem

Borrowing from Falcocchio and Cantilli[1], we established a definition of disadvantaged to include (a) the handicapped (physical and mental), (b) the elderly (over 65), (c) the poor, and (d) the young (under 18).

Depending on how categories are defined, this above set indeed includes many citizens who are denied adequate access to jobs, shopping, recreation, medical care, and social interaction because they face economic and system design and operation barriers to transportation. Falcocchio and Cantilli (page 4) suggest that the above four categories of disadvantaged might include from 25% to 50% of the United States population. Material provided by Ms. Patricia Cass (UMTA)[2,3] indicates (1970 Census data) that roughly 6.5 million persons under 65 suffered from handicaps that could cause difficulties in using mass transit systems. In 1970, there were some 20+ million persons over 65 of which it is estimated that one-third are travel handicapped in some way. The set of handicapped and elderly with travel difficulties due to system design and operations, includes about 13.4 million persons (1970 data). Census projections[4] indicate a growth of elderly to 28 million by the year 2000. Defining the poor as individuals earning less than $2,101 per year[1], approximately 12% of the 1972 United States population were "poor." The young are a group with unique transportation access problems. The participants in this special session identified what we perceive as a trend relating to the transportation needs of youth--a pattern which might be considered as one of those "surprises" we were asked to identify. Women's liberation, equal employment opportunities, increasing numbers of single-parent households, and households in which both parents are employed--all of these imply changes in transportation needs of children and youth. The transportation requirements of unaccompanied children are perhaps inadequately met by present intercity transportation systems in terms of (a) economic, (b) system design, and (c) system operation parameters.

Observations of Session Participants

Exploration of transportation problems of the disadvantaged have primarily been addressed to disadvantaged in urban settings. Much less

attention appears to have been given to intercity and rural disadvantaged. UMTA, however, indicates in Reference 2 that of the 1970 total set of all elderly and handicapped (26.5 million), about 44% live in "non-urban" areas (less than 50,000 population). While transportation problems and solutions for urban, intercity, and rural disadvantaged are similar in many respects, there are also many instances in which requirements and constraints are unique. These considerations suggest a need for more exploration as to the unique transportation needs and problems of intercity and rural disadvantaged.

It was observed that some disadvantaged groups such as the handicapped and elderly seem to be successful, contemporarily, in improving their access to transportation. Public attitudes seem favorable toward improvements which ease travel for the elderly and handicapped.[5] Section 502, of the 1973 Rehabilitation Act (P.L. 93-112) sets up an Architectural and Transportation Barrier Compliance Board which seeks to set in motion processes to remove these barriers. Federal, state, and local governmental actions exist to enhance the travel opportunities of the elderly. Transportation demonstrations for elderly exist which range from free to reduced fares. Evidence suggests that the elderly are more politically active than other age groups and are likely to increase their political activism in the future. See for example, the consciousness raising activities of Maggie Kuhn and the Gray Panthers.

Our session group asked what might happen to our transportation systems if other disadvantaged groups such as the poor, youth, and working mothers found political routes to fulfillment of their transportation needs.

Some concern was expressed at the cost and feasibility of providing special equipment for the handicapped on all transport vehicles. Would it not be more economical to provide them with private service in specialized equipment--kind of separate but equal facilities? An observation was made that there have been some problems in our society in the past with "separate but equal" arguments and arrangements.

Recognition was given to the problem of vandalism and property destruction in transportation systems used by some classes of the disadvantaged--the young and the poor. Until these behavioral problems are solved, some modes of transport such as intercity bus may well be difficult to improve regardless of the investment made in them. Some participants asked a "chicken and egg" question. If facilities, equipment, the system, and the human relationships in the system (between travelers and providers of transportation) could in some way be improved, would not traveler behavior toward the system improve? Does not a degraded system carry with it the seeds of further degeneration? Other participants asked if there are "technological fixes" for traveler vandalism. Is it possible to design a destruction-proof bus? Some efforts have been made in that direction. It was observed that passenger behavior is not as great a problem in systems that carry a population "mix" of low and middle income passengers at the same time and in the same cars.

Intercity transportation for the disadvantaged is complicated by inadequate terminal facilities, and difficulty in transfer from one mode or operating company to another. Young, old, poor, and handicapped in differing ways encounter problems in physically transferring between vehicles, perhaps in proprietary terminals, located some distance apart with poor connecting transport. They encounter special problems if they attempt to explore their transportation options. Transportation information systems need improvement so that persons can more adequately understand their transportation alternatives and negotiate the system more easily.

Transportation equipment itself is in need of human-factors (ergonomic) studies relative to the unique motor, perceptual, cognitive capabilities, and capacities of the disadvantaged.

Summary--Some Things to be Considered

These are not in any rank order of importance.

1. There is need to explore more thoroughly the transportation system implications inherent in trends and changes such as:

    a. The changing role of women in our society.

    b. Single-parent trend.

    c. Two working-parent trends.

    d. Youth transport requirements in view of items a to c above.

2. What are the unique characteristics and requirements for intercity transport of the disadvantaged as contrasted to the more studied urban transportation requirements?

3. What are the unique characteristics and requirements for rural transport of the disadvantaged?

4. What are the relationships between intercity and rural transport of the disadvantaged and their employment problems?

5. Can communications technology substitute in some ways for transportation deficiencies and thus aid certain classes of disadvantaged in their employment options? See the paper by Overby, Hutchinson, and Wiercinski, Reference 6.

6. How should terminals be designed so that the disadvantaged as well as "all" travelers can more effectively use the facilities and satisfy their transportation needs?

7. What unique human-factors considerations need be addressed in specific transport equipment designs to meet the needs of the disadvantaged?

8. How should passenger information systems be designed so as to enable handicapped and "all" travelers to:

    a. Negotiate any given trip with minimum confusion.

    b. Find and sort out alternative transportation options with minimal delay and confusion.

9. What kinds of legislative and/or agency actions relative to transport and the disadvantaged exist in federal, state, and local government and through private philanthropic agents? There are a multiplicity of such actions and activities. Perhaps study is needed to more clearly understand them with an eye toward systems integration possibilities.

10. Would the quality of life for the elderly be improved by improved transport options? Do older persons increase their social interactions given better transportation options and does this lead to greater life satisfaction? To what degree does intercity and rural transport availability relate to the quality of life for the elderly and handicapped? See the Drevenstedt paper, Reference 7.

11. Are there technological fixes for vandalism and destructive behavior on public transportation systems? Is it more appropriate to downgrade the search for technological fixes in favor of social and behavioral change agents?

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Energy Options for Intercity Transportation

Discussion Leader: George Hoffman

This session was a technology assessment of energy options for intercity transportation and focused upon the relative impacts of energy futures.

The impacts and consequences of fueling vehicles to come in the next half century were primarily upon:

- Socioeconomic trends
- Industrial and processive activities
- Biophysical health of the populace
- Land use and siting of generators
- Innovative and synergistic attitudes
- Ecologic and environmental situation

Synthetic fuels command our attention through the next 50 years; first from fossil and later from renewable or perpetual resources.

Fuels that were discussed were: LH_2 (liquid hydrogen), metal hydrides, cryomethane, methanol and ethanol, synthetic gasolines, and synthetic diesel and kerosene fuels.

Nonfossil resources for fuel synthesis were considered to be nuclear, solar, wastes, crops, and combinations thereof, and other minor potential energy starting points; though main emphasis was on the renewable sources such as solar, agricultural, or maricultural generation of hydrocarbons that are liquid at ambient temperature.

It was concluded that into the more distant and opaque future beyond our half-century-hence purview, the latter part of the 21st Century would be all-electric in its intercity transportation vehicles, with the exception of aircraft. Well before that electrifying event, our panel could not conceive alternatives to synthetic hydrocarbons, (gasoline- and kerosene-line fuels) for fueling the engines of most long-range vehicles such as automobiles, trucks, and buses for intercity travel.

The renewable resources for synthetic, nonfossil fuels were forecast to be ample (e.g., solar, land, or sea farms). It was predicted that coal, on the other hand, would be extremely scarce or expensive in a few decades.

Continuing investments of one-tenth of the GNP yearly would be required to start up the new synthetic fuel industries. New refinery technologies would have to evolve to handle liquified coal, kerogen, and syncrude from solar sources and crops. The photolytic H_2-generating process appeared to have the least environmental impacts, vis-a-vis thermocracking and electrolysis.

Methane from wastes, silviculture, mariculture, and fuel from crops need large-scale demonstration but promise to be alternate sources for low-cost, efficiently made, environmentally benign fuels to energize inter-city transportation vehicles. A recommendation was made to Energy Research and Development Administration (ERDA) to consider studying in greater depth the conservational and technology assessment of synthetic fuels from wastes, farms, and special purpose harvests.

The synthetic fuel industries will in turn generate conflicts with urbanization, water allocation, air quality enhancements, coastal marine and aquatic farms, reclamation, and capital formation rates.

The uses of methanol were seen to be relegated to peak-sharing turbo-generators; captive vehicle fleets; and as an additive to gasoline, diesel, and kerosene. The oil industry and the American Gas Association are actively working on synthetic fuels from nonfossil resources and these research, development, and demonstration (RD&D) situations seem well started though perhaps underfunded.

Regulation/Deregulation

Discussion Leader: E. T. Haefele

The panel addressed itself to six questions. The questions and answers in summary form were as follows:

Question #1. If the rail guideway system were publicly owned, could it be managed *a la* FAA with both common carriage and private carriage of freight and passengers? If so, would private carriage (company-owned freight cars and trains) actually develop on the trunk lines? Is it likely that transport companies, using several modes of transport, would develop, perhaps by freight forwarders or by expansion of companies such as United Parcel?

Answer #1. There were felt to be no very serious technical problems arising in an FAA-type control of rail guideway. It was assumed that only the major trunk lines would be publicly owned (at least by the federal government, although the states might pick up some of the more important branch lines in their states). The technical problems that were identified were the problems around who owns the marshalling yards and who controls them.

A more important problem was that of the pricing policies to be used to control entry, weight (the overloading problem might be severe), and the cost of using the lines. It was generally felt that the federal government has not been able to adopt rational pricing policies elsewhere (airports, for example); and thus, there was little room for optimism about its ability to price correctly for the use of the rails. Moreover, most felt that the problem of finding optimum price levels was intrinsically a most difficult economic problem. In sum, political forces would probably prevail.

Private carriage of freight would probably develop, as well as transport companies. Rail passenger service would still have to be a publicly provided service.

Overall, there was strong feeling that the whole idea could work, but that it would offer no strong economic benefits to the country. It was not felt to be a "solution" to the present rail problems of the country.

Question #2. If we assume broad deregulation of entry, abandonment, pricing, etc., in all transport modes, will there be some regions of the country that would be severely disadvantaged relative to the present, such that political pressures from those areas would be strong enough to reestablish regulation and/or create great subsidy programs that vitiate the whole idea?

Answer #2. In a word, no. While some areas would, undoubtedly, suffer by deregulation, it was felt that they would neither be so numerous nor

so powerful that they could change national policy, once established. In this regard, the flexibility of truck, bus, and auto to respond to such areas was felt to be sufficient to keep the areas from undue (read political) hardships.

Question #3. Would a policy of broad deregulation in all modes of transport have any effect on transport technology?

Answer #3. Price competition in the air passenger area might well provide incentive for the development of cheaper (i.e., more cost effective) aircraft. No important technological effects were foreseen in the other modes.

Question #4. Is there enough resiliency left in the private rail sector so that, given broad deregulation, the private sector could reestablish a viable trunk rail network by the year 2000?

Answer #4. The opinion of the group was unanimous in feeling that it was. Since that opinion was not shared by the discussion leader, I queried many other participants on this question. I found that everybody felt that it could be done, and if regulation was removed, it would be done.

Everyone felt, of course, that present rail managements would have to be replaced, and that they would be, as the first step in getting new large infusions of private capital. There would be wholesale abandonment (perhaps 50% to 70% of the present system). There was no feeling that the guideways have deteriorated too far for recovery. There was strong feeling that the basic economies of rail trunk lines were such, that given freedom, private lines could and would make money.

The experience of the Southern Railway System, as a hard-nosed rail-oriented management, was cited repeatedly in support of this contention.

Question #5. Given a choice between the system that would develop under public ownership of the trunk rail network and that which develops under deregulation (privately), which would be in the best economic interests of the country?

Answer #5. All felt that the system which could develop privately would be best, although (and here it is clear that I did not have just a group of knee-jerk private enterprise types in my session) all also felt that such a private system would have to be supplemented by government investment in selected areas (e.g., in the passenger area) and perhaps in some interregional connections that might not develop privately but would be necessary for the country as a whole.

Question #6. Is there an efficiency-safety trade-off? That is, to the extent that government regulations continue to go down the path of insuring greater user safety in all modes of transport, are we likely to lose more and more efficiency in a narrow sense?

Answer #6. At first, there was a feeling that there was no trade-off, i.e., that efficiency and safety went together, that investments in efficiency gains added to safety and vice versa. Later, particularly in air, estimates were made that, with a little lowering of the safety standards, airport utilization could be doubled and no new airports would be needed in this century. No resolution of this issue was made, but I think the feeling was that this issue had not been thought out, and no one really knew what the answer was, either in particular modes or as a general proposition. The emotionalism surrounding it is such that even technically trained people are likely not to think about it very hard. It is an area for study that deserves to be raised.

V. SYNOPSIS OF SPEAKERS' REMARKS

Three speakers addressed plenary sessions of the Technology Assessment of Intercity Transportation Systems Workshop.

Alan M. Lovelace
Associate Administrator for Aeronautics and
Space Technology
National Aeronautics and Space Administration

Subject: Welcoming Address

William E. Stoney
Acting Assistant Secretary for Systems
Development and Technology
Department of Transportation

Subject: Factors to Consider in Transportation
Technology Assessment

John W. Barnum
Deputy Secretary
Department of Transportation

Subject: National Transportation Policy

This chapter summarizes the speakers' remarks.

Remarks of Alan M. Lovelace

Welcoming Address

The purpose of this Workshop is to examine the various possibilities for new intercity transportation systems (not just individually, but in rational combinations, with full recognition of interface problems), to study the potential impact of such systems on society, and where possible, to identify modifications that would reduce adverse impacts and increase the likelihood of acceptance.

From the standpoint of research and technology preparation, it is not necessary to forecast exactly which advanced systems will evolve. Our technology work will, in fact, *influence* the eventual choices.

No one of the scenarios you have received represents a situation we could all be satisfied with; no one of the technology descriptions represents a clearly viable system; yet each represents a possible future.

The output of the Workshop should include a more complete evaluation of the interactions between the technical and socioeconomic systems described in the scenarios. It should also assess the potential changes in society due to implementation of technology, and the technology changes required by social pressures. Such changes need to be identified early in the processes of system definition and technology development.

We are not here to vote on the best scenario, or to optimize a transportation system for the year 2000. We are here to consider the strengths and weaknesses of the various technological approaches within a number of social and economic contexts, so that we can apply our research and development capabilities to maximize the strengths and minimize the weaknesses.

Remarks of William E. Stoney*

Factors To Consider in Transportation Technology Assessment

When we talk about alternative transportation systems for the future, we should view them as options that may be selected or rejected for actual implementation under conditions and criteria different from today. While we cannot predict the future, we can develop some of the basic characteristics of transportation systems, such as infrastructure costs, which will affect the options we choose in the future.

While all systems can operate at lower unit costs with higher demand, detailed cost characteristics differ dramatically between air and ground modes. For ground systems, the infrastructure, which consists principally of the guideway and terminals, is a major cost component. In contrast, the infrastructure for the air system is concentrated in the airport/terminal/air traffic control complex. The size and costs of this infrastructure can largely be scaled to demand.

The large fixed annual cost for ground modes and its method of recovery are major factors in shaping how the network evolves. The obvious approach is to require that each element in the network recover its full annualized cost. This means that cost per mile on each element of the network would vary according to patronage. The alternative is to charge a constant per mile fee to recover the total cost of the system without considering the cost of any one element. This results in the heavily traveled segments generating surplus revenue which can be used to offset the revenue deficit of the less densely used elements. Average price is an important determinant of effectiveness of this approach. One might observe that a price exists which generates the maximum revenue for any network configuration. This revenue and the network cost can be balanced to yield a maximum network configuration.

In transportation systems, the objective should be to optimize the whole system, not individual links and nodes. Optimum efficiency will, in general, require internal cross-subsidy between system elements.

Infrastructure costs are only one part of the total cost to the user. The other costs depend on many variables that are subject to change due to external forces, but there is an economically optimum speed at which the combined costs of labor, vehicles, energy, etc., are minimum. Detailed operational characteristics for each mode also influence operating costs.

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*Mr. Stoney's address included several graphs and charts that are not reproduced here.

The net effect of combining the various costs suggests the areas of optimal performance for each mode. TLV is competitive with air in speed out to nearly 250 miles but is less expensive only at the higher demand levels. At lower demands, air is both the least expensive and the fastest mode. The least expensive modes in all cases are the shared rail and bus systems since they are required to pay only a share of the guideway costs.

These comparisons relate only to the line-haul speeds and costs. In practice, mode choice is based on many other factors such as total trip time.

Because of the potential for more direct travel, auto has an advantage not reflected in the line-haul speed. Common carrier modes require additional time for access at the origin, delays in mode transfer at both ends, and further delays in traveling to the final destination. Without offsetting considerations, auto is superior to other highway modes. The faster line-haul modes do provide a shorter total trip time beyond some minimum distance. But even for trips where common carrier modes have a speed advantage, other factors such as cost, ground travel, convenience, etc., will be involved in modal choice. While we can and should compare line-haul speeds, the results must be evaluated within the context of the total trip for a large variety of users.

Another important factor is our basic technology goals, the most important of which is to make all modes more energy efficient. Others include increasing speed, improving operation for low-density ridership, and refining automation.

Transportation is one of the major factors that shape the growth of the nation. Its physical network determines accessibility to our land resources, and its speed dictates our travel habits. Regardless of the form of future systems, our programs should provide options or alternatives that society and policy-makers can exercise, as appropriate.

Technology provides alternatives for change, hopefully improvements, in the transportation system. In terms of speed, network extent, and cost of service, these alternatives will enable the realization of different objectives of physical, social, and economic organizations.

Remarks of Deputy Secretary of Transportation John W. Barnum

National Transportation Policy

What is our national transportation policy? That question has been asked and answered in many ways over the years. It is a perennial issue. Transportation, after all, is one of the basic threads which knits our society together and which connects us with the rest of the world. It is also a major determinant of our quality of life--mostly for the better, but sometimes for the worse.

Transportation policy--like any other policy-- is not an isolated entity. It is responsive to and involves interaction with basic societal goals. It is also continually evolving--to meet changed conditions, or altered priorities, or expanded knowledge.

When former Secretary of Transportation Brinegar gave a progress report to Congress in the spring of 1974 on national transportation policy, he drew a very useful distinction between goals, policies, and programs. Policy, he said, is "the necessary link in the never-ending process of translating the many and often conflicting national goals into specific action programs." Of course the division between the three is never very clean in practice. Goals, policies, and programs interact in a manner both complex and subtle. But too often when people ask about transportation policy, they really want an answer about transportation programs--how much money will go into highway construction, which ports will handle supertankers?

Secretary Brinegar set out ten principles by which national transportation policy should be guided. They remain valid and are worth summarizing briefly:

1. The broad objective of federal policy is to insure that the nation has a transportation system which meets its essential needs and which is efficient, safe, fast, and convenient, while limiting to the extent feasible its negative impacts on the environment.

2. The competitive forces of the private sector can and should be relied on to provide the bulk of the nation's transportation system. Secondarily, state and local governments should have this responsibility. Direct federal financing of transportation investments and operations should be scrupulously limited.

3. Where federal money is used, it should be recovered from users and other beneficiaries unless important national objectives direct otherwise.

4. Economic regulation of transportation industries needs revision to allow greater play of free market forces and to promote intermodal competition.

5. Energy conservation, safety, environmental protection, and accessibility for the disadvantaged (the poor, the elderly, the handicapped) are issues inextricably involved in transportation decisions and often point in different directions. We must find a way to resolve the conflicts which arise.

6. Large urban areas present severe transportation problems, and these problems relate closely to other urban issues. A special federal effort is required in this area.

7. Rural public transportation needs must be further defined and solutions explored.

8. Intermodal cooperation and integration needs to be fostered and existing unnecessary restraints removed.

9. Federal research and development activities should center on a limited number of programs which are not likely to be undertaken without federal support and which promise payoff to the nation as a whole.

10. There must be a continuing effort to advance the overall level of our knowledge of the nation's transportation system, its capabilities, and its problems.

Later this month [September 1975], Secretary Coleman will issue a Statement of National Transportation Policy setting forth the broad policy considerations that should underlie the federal response to the nation's transportation needs. I do not propose to give a concise synopsis of what is contained in the Secretary's statement. It merits full and careful reading, and I commend it to your attention. Indeed, your general reaction and your specific comments will be most welcome. If there ever is to be a definitive exposition of national transportation policy--which is problematic given its evolutionary nature--it can only be after full

consideration of the views of other levels of government, industry, users, and transportation experts of various kinds.

The basic point I would make is that we ought to have a transportation system. You know very well that a system is something composed of parts making up a complex but unitary whole. An efficient system is one in which the parts work together and complement one another. That's what we should be aiming for.. An inefficient system is one in which the wrong parts do tasks for which they are not suited or the parts work at odds with one another or duplicate each others' efforts. That, all too often, is what we have today.

First, we want to examine the components of the system. For what functions are the railroads, airlines, barges, trucks, cars, and pipelines best suited? Each mode has inherent capabilities, and within each mode, various levels of service can be offered. How can all this be fitted together in the most efficient and cost-effective manner--with cost-effectiveness taking into account not only direct monetary costs, but also environmental and energy considerations?

An example is the case of intercity movement of freight. Where waterways exist, barge traffic can move bulk freight very efficiently, with little environmental impact and low energy utilization. There are costs, however, of building and maintaining waterways and waterway facilities. These costs are not today reflected in the rates charged by waterway operators, because the federal government--that is the general taxpayer--through the Corps of Engineers and the Coast Guard picks up the tab for construction, maintenance, and safety of the right-of-way. This is in stark contrast to the railroads, the closest competitor of the water carriers, which own, maintain, and pay taxes on their rights-of-way.

Although every president since Eisenhower has recommended that some form of user charge be placed on the waterways, as part of a basic transportation policy that the beneficiary should bear the costs of the service received, Congress has not yet seen fit to act on this policy direction. Were waterway operators required to bear their fair share of the costs and were that reflected in the rates charged, railroads and water carriers would be more competitive and the present situation of government involvement creating competitive imbalance between those modes would be largely corrected.

Railroads are energy-efficient carriers of bulk loads between major points. Because they require dedicated, exclusive rights-of-way, with consequent monetary and environmental costs, they are best used for long distance, high-density traffic. It does not make sense to have a proliferation of rail lines which carry only a few boxcar loads a day. That sort of feeder traffic can be handled more efficiently by trucks.

Trucks can best serve in a feeder capacity and where traffic density is insufficient to justify rail service. Trucks offer flexibility; they can go anywhere there are highways and our highway network is extensive. They are not, however, energy efficient when compared with rail or water, and their use for long distance hauls which can be served adequately by these other modes should be curtailed.

Air cargo and pipelines offer special service for particular commodities and can be used effectively in their respective spheres.

In intercity passenger travel, we have planes, railroads, buses, and of course, the automobile. Presently over 85% of intercity passengers travel by car, compared to about 2% by bus and less than 1% by rail. Given the environmental, energy, and safety consequences of automobiles, we need to do two things: improve the car and make the other modes more attractive.

Commercial airlines operate everything from 747s to six-seaters. All too often, however, we find large aircraft operating in markets which smaller aircraft could serve as effectively and more efficiently. I look forward to an airline industry in which the trunk carriers serve the major hubs, while local service, commuter lines, and air taxis take care of the short-haul, light-density city-pairs and provide the feed to large carriers. This would be efficient and profitable for the companies concerned.

The future of rail passenger service is somewhat cloudy. Traffic density is again the key, and in certain corridors--such as Boston-New York-Washington--rail service must be maintained and improved. But I would say the number of those corridors are limited.

Buses offer flexibility, again, since they use the highways. They are perfect for the short-haul markets and for those which don't have the necessary density to warrant rail or air service.

Central to this picture which I have been drawing is the concept of intermodalism--the effective integration of the various parts of the system. Intermodalism must be strengthened--utilizing joint terminals, through ticketing, and multimodal ownership--before the system can operate at its full potential.

This is an idealized picture. There is not a hard line to be drawn between where freight should go by rail or by truck, between where different aircraft should be operated, and so on. Moreover, I would not propose monopoly operations. Effective inter- and intramodal competition is both healthy for the industries and vital to the consumer.

Appendix A

PARTICIPANTS

Appendix A

PARTICIPANTS

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Panel 1

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R. K. BEST, presently Chief Deputy Director, California Department of Transportation. He has a A.B. in economics from Stanford University; J.D. from McGeorge School of Law at the University of the Pacific. Formerly Deputy Director, California Department of Social Welfare; Chief Deputy Director of the California Department of Health. Also, Adjunct Professor of Administrative Law and Social Legislation at the University of the Pacific.

RICHARD E. BLACK, Director, Advanced Design, Douglas Aircraft Company, a division of McDonnell Douglas Corp. In his current position, Mr. Black is responsible for the preliminary design of all new products of the Douglas Aircraft Company. This involves the evaluation and application of many new advanced technologies. The purpose of Mr. Black's efforts is the generation of customer interest in promising and exciting new programs. Prior to his current assignment, Mr. Black served Douglas as Chief Engineer Super DC-8 Program, and as Chief Designer. This was a highly successful evolutionary development of the basic DC-8 passenger jet. Mr. Black has been with Douglas for twenty-six years and is the author of numerous technical papers. Associated Fellow, AIAA; Member, SAE. B.S. and M.S. aeronautical engineering, Pennsylvania State University.

JAMES C. GOODRIDGE, Assistant Investment Officer, is responsible for long-term debt financing of transportation companies at Connecticut General Life Insurance Company. His duties include the management of a private placement and public bond portfolio comprised of airline, railroad, shipping company, and freight forwarder debt securities, participation in the Penn Central reorganization through the bondholders' creditor group, and liaison with government transportation agencies.

LAWRENCE (Larry) GREENE, Assistant for Aero R&D and Acting Director R&D Plans and Resources, OST/DOT; Education: Physics/Liberal Arts/Aero Engineering. Joined North American Aviation in 1943, Project Aero on F86, active in all designs through B70. Became V.P. Res. & Engr./L.A. Division, V.P Marketing and Plans/L.A. Division; Corporate V.P., Assistant to President for Technology Transfer. Joined DOT in 1969 as Executive Director, CARD Study.

NORMAN P. HUMMON received his Ph.D. in sociology from Cornell University in 1973. He has held the position of Assistant Professor of Environmental Systems Engineering and Sociology at the University of Pittsburgh since 1971. His research has included work in urban systems simulation models, dynamic models of social systems, and spatial analysis. He is currently conducting research for DOT on alternative roles of the automobile.

THOMAS J. O'BRIEN, Federal Aviation Administration engineering and development; Pratt & Whitney Aircraft--advanced engine development; Civil Aeronautics Board--Air safety analysis; Federal Aviation Administration--SST development program, environmental regulation and research, aeronautical satellite development, advanced air traffic control system analysis, and airport improvement; Mobile Oil Corporation--government interchange executive, advanced aviation products.

ROY PULSIFER, B.A., M.I.A., J.D. (Columbia University). Assistant Director, Bureau of Operating Rights, CAB. With CAB since 1963; previously with FAA, IATA. Project Director and co-author of various government studies in field of air transportation.

WILLIAM M. SPREITZER, twenty-four years of research activity in the automotive industry, the last nine in the administration of research on transportation and urban analysis. Included is work in travel forecasting, travel demand analysis, technological forecasting, and case studies of innovative systems of public and private transportation.

C.A. SYVERTSON, presently Deputy Director, NASA Ames Research Center, Moffett Field, California. General background is Aeronautical Engineering; specialized in high-speed aerodynamics early in career. Was first director (1963-1966) of advanced study organization, Mission Analysis Division, that was precursor to NASA organization sponsoring present study. In 1970-1971, was on loan to DOT as Executive Director of Joint DOT/NASA Civil Aviation Research and Development (CARD) Policy Study.

Panel 2

LARRY DAY is Staff Supervisor of Business Planning at Bell Canada in Montreal. He is responsible for the management of a team of professionals who conduct technological forecasting and assessment studies in the computer and communications fields. One area of research conducted by this group that is relevant to the NASA/DOT study has been an extensive examination of the future potentials for trade-offs between travel and communications.

JEROME HINKLE, educated in physics and public policy analysis; coordinator of policy research for University of Michigan SEA Grant Program. Natural resources policy research in the Environmental Simulation Laboratory at the University of Michigan. Worked on the use of technology assessment in policy for the U.S. Environmental Protection Agency (alternative fuels)

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DAN MAXFIELD, experience in transportation system planning analysis and evaluation for networks and individual airports. Participated in National Transportation Study, Civil Aviation Research and Development Policy Study and the legislative process leading to the Airport-Airway Development Acts. Operations research experience in model building. Prepares forecasts, capacity/delay analyses, and estimates of facility requirements and socioeconomic impacts.

WILFRED OWEN has been involved in public policy studies of transportation in relation to economic and social development in the U.S. and abroad.

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Panel 3

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Assistant Vice President--Equipment Engineering, construction and maintenance for AMTRAK, 1973 to date.

GEORGE V. BRODERICK, Office of Program and Policy Planning, Federal Highway Administration. Relevant experience--research on highway right-of-way acquisition, and on social and economic impacts of highway programs. Environmental impact of highway programs including energy and other resource consumption, land use, noise, air pollution emissions, and aesthetic and ecological considerations.

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GREGORY T. HAUGAN, currently responsible for implementing portions of the Regional Rail Act that calls for immediate improvements to its Northeast Corridor and engineering and planning for a major improvement to rail passenger service on this Corridor. Previous experience included R&D planning and management in the Office of the Secretary U.S. DOT, planning and analysis for the Federal Aviation Administration on the SST program, and industry experience in engineering and planning at Bunker Ramo, the Martin Company, and McDonnell Aircraft. Education includes a B.S.M.E., M.B.A., and Ph.D.

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CHARLES OVERBY, Industrial & Engineering Department, Ohio University, has teaching and research interest in applied statistics, human factors (including work organization and design) and technology-society issues (including energy), and engineering economics. Has a general interest in the transportation-communication trade-off, with a specific focus on information handling employment options for immobile persons. He enjoys travel and is a general aviation pilot with commercial and instrument ratings.

GERARDUS J. SCHOTT, Boeing Commercial Airplane Company, directed various studies related to the energy crisis, including energy, emission, and noise comparisons of intercity passenger transportation modes, freight energy efficiency comparisons, and alternate fuels for aviation. Major background: aircraft propulsion.

JOSEPH G. STIEBER, Vice President, Engineering, Greyhound Lines, Inc. With Greyhound for 29 years starting as project engineer. Prior to Greyhound, associated with Douglas Aircraft and Curtis-Wright as design engineer. Former member SAE Technical Board, Chairman NAMBO Vehicle Standards Committee, Member NAMBO Safety and Maintenance Committees, member SAE Truck and Bus Tech. Committee; SAE Automotive Council; General Standards Council ASTM Fuel and Lub. Committee.

HAROLD E. ROLAND, Chairman of the Department of Safety Technology of the Safety Center of USC, engaged in teaching and research of Safety Analysis. Military test pilot with a M.S. in aeronautical engineering and a Ph.D. in engineering with major fields of transportation and engineering economy. Currently principal investigator of a DOT research effort for investigation and analysis of Bicycle Motor Vehicle Accidents. Consultant in Safety Analysis to the Washington, D.C., Metropolitan Transit Authority.

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GRANT P. THOMPSON, a graduate of Oxford University and Yale Law School, is Institute Fellow at the Environmental Law Institute, where he heads the Institute's energy research program. He is co-author of *Energy and the Social Sciences* and served as a chairperson at NASA's Portable Energy Workshop last year.

JOHN J. (Jack) FEARNSIDES, Chief, R&D Policy Implementation Division, Office of R&D Policy Manager, Advanced Research Program Office of Systems Engineering. Both jobs are in the Office of the Assistant Secretary of Transportation for Systems Development and Technology.

DR. ANNE R. HEADLEY, has received undergraduate and graduate education in anthropology, and has had professional experience at the Environmental Protection Agency, the Federal Power Commission, and the Federal Energy Administration in relating land use to water pollution control, energy conservation, and resource development, respectively. Graduate training and professional experience in natural resource law and international relations has exposed her to both the jurisdictional and human rights aspects of land use.

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Gerald Kayten--NASA-Headquarters
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Bill Spaeth--Transportation Systems Center, DOT

Panel 2

Bill Garrison--University of California, Berkeley
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Panel 3

Dick Shevell--Stanford University
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Appendix B

SUMMARY DESCRIPTION OF STUDY TECHNICAL REPORTS

Appendix B

SUMMARY DESCRIPTION OF STUDY TECHNICAL REPORTS

This appendix provides a capsule summary of the six study technical reports (TRs) that were distributed to study participants before the Workshop and served as a basis for some of the discussions. Subsequently, the technical reports were revised and are incorporated in other volumes of the final study report, as noted below.

TR1. Identification of Issues Affecting Intercity Transportation (now Vol. 2)

Issued in three parts. Parts II and III contained drafts of issue papers listed in Table B-1. Part I was a summary of these papers and other special interest documents that were prepared for the project.

Distribution of Parts I and II to study participants began on July 23, 1975. Part III was among the last of the reports that were mailed to participants in late August.

TR2. Background Scenarios of Possible Future States of Society (now Vol. 4, Part A)

Contained descriptions of the four background scenarios used as backdrops in descriptions and assessment of possible future transportation technologies. A capsule summary of the background scenarios is given in Table B-2.

TR3. Description of Transportation Scenarios (now Vol. 4, Part B)

Presented qualitative descriptions of intercity transportation systems that might be in operation in the year 2000. It also described a series of postulated events that rationalize how the year 2000 systems might evolve. The systems were based, in part, on Technical Report No. 6, but a substantial amount of imagination was also applied. A summary of the systems is given in Table B-3.

TR4. Analysis of Transportation Scenarios (now Vol. 4, Part C)

Described the results of quantitative analyses of the year 2000 intercity transportation systems posed in Technical Report No. 3. Measures included patronage, revenues and operating costs, energy

consumption, and traffic safety as developed through case study analysis of cirridors and city-pairs. An example of patronage results is given in Table B-4.

TR5. Impact Evaluation

Reported the identification of basic impact information in several categories following from Technical Reports Nos. 1 through 4 (e.g., political roles and conflicts, personal mobility, secondary economic effects) and presented a framework for continued assessment of issues and technology impacts at the Workshop and beyond. (The post-Workshop impact assessment is reported in Volume 6.)

TR6. Technological Characteristics of Future Intercity Transportation Modes

Explored technological possibilities foreseen for transportation for the year 2000 and immediately beyond. For modes likely to be viable candidates in this time period, detailed technical, economic, and environmental characteristics were given. Contained a brief summary and separate sections on air, rail, high-speed guided ground transportation, and highway modes.

Table B-1

STUDY ISSUE PAPERS IN TECHNICAL REPORT NO. 1

H. Bruck, *Resource Availability Inputs to Intercity Transportation to the Year 2000: With Special Reference to Energy Resources.*

J. P. Carter and B. Bernhard, *Organizational and Regulatory Issues in Intercity Rail.*

R. H. Doyle, R. W. Schmidt, and D. M. Cullivan, *The Future of Concern for the Environment.*

W. L. Garrison, *Current and Future Forms of Intercity Passenger Transportation.*

A. Gellman, et al., *Constraints to the Implementation of Intercity Transportation Innovations.*

D. W. Jones, Jr. and J. F. Miller, Jr., *The Congressional Politics of Transportation Expenditure: Implications for the Future.*

D. W. Jones, Jr., *The Transportation/Communication Trade-off.*

E. Koenigsberg, *Goods Transportation.*

J. Mollenkopf, *The Auto-Industrial Era--Is It at an End?*

R. Whorf with J. Grocki, *Impacts of Regulation on Intercity Transportation, 2000 A.D. and 2025 A.D.*

R. Whorf and W. White, *Social Impacts on Intercity Transportation.*

R. U. Ayres, *Macroeconomic Issues for the Year 2000.*

J. P. Price and R. W. Luce, *The Impact of the Financial Environment on Intercity Transportation.*

W. L. Garrison, *A Note on Technology Pessimism.*

Vincent Roggeveen, *Trends in Freight Transportation.*

Table B-2

BACKGROUND SCENARIO SUMMARIES

Scenario I--National emphasis on economic development and encouragement of business . . . Relaxation of many business controls . . . Slow population growth oriented to suburbs near major cities . . . Considerable growth in wealth and capital formation . . . Worsening international tensions, resource cartels, and economic warfare . . . High capital and resource costs . . . Considerable R&D and large-scale innovation . . . Privately financed transportation innovations in dense markets, minimal service in sparse markets.

Scenario II--National emphasis on restraint of big business and big government and encouragement of competition and entrepreneurship . . . Control of large corporations through forced public disclosure, antitrust, and some nationalization of floundering companies . . . Steadily increasing population oriented to medium-size and nucleated cities . . . Moderate growth in wealth and capital formation . . . Some relaxation of international tensions and favorable trade conditions . . . High capital and moderate resource costs . . . Considerable R&D and diffuse innovation . . . Considerable transportation innovation.

Scenario III--Consensus-oriented political leadership, with flexible policies aimed at mediating competing demands of well-organized interest groups . . . Much planning and adjudication prior to major public and private developments to prevent social and environmental damage and to achieve widest incidence of benefits . . . Growing complexity and inefficiency in public and private services, with increasing government subsidy in many areas . . . Slow population growth concentrated in existing cities and suburbs . . . Extremely slow economic growth . . . Avoidance of foreign involvement with loss of U.S. dominance in international markets . . . Moderate capital costs . . . Moderate resource costs initially, followed by a severe energy crisis in the 1990s . . . Moderate R&D expenditures with slow implementation of innovations, particularly in the transportation sector.

Scenario IV--Emergence of a strong political coalition committed to ambitious social and economic reform . . . Strict government control of key enterprises and eventual government ownership of many . . . Major growth in public services . . . Steadily increasing population oriented to medium-size cities and nucleated metropolitan areas . . . No-growth economic policy . . . Considerable relaxation of international tensions . . . Low capital and moderate resource costs, but with heavy taxation of private resource use . . . R&D closely focused on national social priorities, yielding significant innovations in energy production and transportation.

Table B-3

TECHNOLOGIES AND SERVICE CHANGES EMPHASIZED

Transportation Scenario[a]	Mode				
	Air	Fixed Guideway	Bus	Auto	Access/Egress
I	Large CTOL aircraft; SST; large improvement in CTOL; some loss of air service; "no-frills" operations. New airports in large cities. Rapid general aviation growth.	Reduced AMTRAK; some IPT.	Better short-haul service, responding to air service reductions. 70-mph speeds.	Improved gasoline autos, Electrified highways and electric autos; 70-mph speeds.	Capacity improvements in airport access freeways.
II	Much commuter service using small A/C; improved CTOL. Moderate general aviation growth; SRA; new airports in medium cities.	AMTRAK discontinued; some private, specialized rail service.	Good bus service; better vehicles; special passenger van services.	Highly efficient auto; some more intercity highways; special auto rentals.	Variety of special access services; satellite terminals. Better intermodel terminals.
III	Little technical improvement; fuel efficient CTOL. Nationalization of airlines late in century.	All rail service is nationalized. Some IPT.	Improved, cheaper buses. Big increase in bus service beyond 1990.	Restrictions on auto use. Minimal highway construction; greatly improved auto fuel economy beyond 1990.	More highway congestion.
IV	Substantial improvement in CTOL; improved small A/C. New airports in medium cities.	Emphasis on TLV.	Good bus service; Better vehicles; 75-mph speeds.	Electric autos; high efficiency in gas autos.	Many fixed guideway transit installations.
Reference Cases (one "set of technology" with varying costs as dictated by background scenarios).	No cost improvement in CTOL; larger average number of seats in CTOL; frequencies as good or slightly better than at present; no new airports.	AMTRAK as today.	Bus service as today.	Somewhat more fuel efficient vehicles; Scenario's fuel prices; No intercity highway construction.	No new fixed guideway transit installations to airports; no urban airport freeway improvements.

A/C = Aircraft
CTOL = Conventional takeoff and landing aircraft
SRA = Short-runway aircraft
IPT = Improved passenger train
TLV = Tracked levitated vehicle system

a. The setting for Transportation Scenario I is Background Scenario I, and so forth.

Table B-4

SUMMARY PATRONAGE RESULTS FOR SCENARIO II
(Compared with Reference Case II)

Mode	High-Density Travel Corridors[a]	Large City-Pairs[b]	Smaller and/or Shorter Distance City-Pairs[c]
Air	Short-runway aircraft service (and attendant decreases in traveler access time and cost) increases traffic by a factor of 2 or 3. Market share doubles.	Small reductions in air fares lead to small increases in traffic (10%).	Commuter air services significantly increase traffic (factor of 3 to 4).
Rail	Significant increases in travel result from improved services (multiples of 2 to over 7). Market shares increase by 10 percentage points.	Widespread discontinuances of service cause patronage decreases. Affected traffic volume is small.	Small volumes of traffic are lost via discontinuances.
Bus	Traffic levels essentially unchanged (service improvements countered by improvements in other modes).	Traffic up by a factor of 2 in response to wider, more comfortable, buses. Market share does not exceed 10%.	Traffic up by a factor of 2; more in the case of small van service. Market shares of 10% to 20% (vs. 10% or less in reference case).
Auto	Decline in volume and market share, relative to reference case, because other modes have improved. Auto slips from majority to plurality of travel.	Modest (10%) increases in traffic due to fuel-efficient vehicles.	Modest (10%) increases in traffic.
Total Traffic	Increases of 30% to 60%.	Increases of 10% to 15%.	Increases of 30% to 100%.

a. Northeast Corridor (Boston-Washington), Chicago-St. Louis, and Seattle-Portland.
b. Los Angeles-Washington, Boston-Denver, Los Angeles-Dallas/Fort Worth, and Atlanta-Detroit.
c. Detroit-Traverse City, Kansas City-Oklahoma City, Stockton-Fresno, and Denver-Billings.

Appendix C

TOPICS FOR ASSIGNED PANEL SESSIONS

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Monday Afternoon, Session 1

Review and discuss the study's issues and scenarios, as described in Technical Reports Nos. 1 through 3.

Please address the following:

1. What are the principal social and economic issues (e.g., Technical Report No. 1) impacting on future intercity passenger transportation that should be addressed at this Workshop?

2. Future settings (scenarios) have been developed in Technical Report No. 2. Is the range of possibilities covered by the scenarios adequate for discussion of issues and for impact assessment? If not, what additions or deletions are suggested?

3. Transportation innovations (e.g., technologies, policies) have been postulated in Technical Report No. 3. Is the range of application of these innovations within and across scenarios adequate for impact assessment? If not, what changes are suggested?

Tuesday Morning, Session 2

In this session, each panel is asked to address one of the study's scenarios, as follows:

Panel 1--Scenario I
Panel 2--Scenario II
Panel 3--Scenario III
Panel 4--Scenario IV

Please comment on the following:

1. Within the general philosophy and spirit of your assigned background scenario (Technical Report No. 2), are there crucial elements of the related transportation scenario (Technical Report No. 3) that must be changed to make it usable for impact assessment?

*This appendix is a copy of the handout provided to study participants before the Workshop.

2. Are there aspects of the analysis and evaluation of your assigned transportation scenario (Technical Reports Nos. 4 and 5, respectively) that need clarification, expansion, or correction?

3. Comment, as appropriate, on the major impacts (positive and negative) of the transportation innovations of your assigned scenario.

Wednesday Morning, Session 3

Three panel sessions--to be held on Wednesday morning, Wednesday afternoon, and Thursday morning--will address impact assessment and recommendations that follow therefrom. During the three sessions, it is not intended that discussions be limited to a single transportation scenario; rather, the potential scope of deliberations includes--but is not limited to--all of the study's scenarios. One of the challenges facing participants is to focus discussions in a way that provides for broad coverage of impacts but also allows for in-depth assessments.

It is expected that panel deliberations will flow continuously over the three sessions; however, to provide assurance that objectives of the Workshop are met, suggested topics are listed for each session.

1. Describe a set of potential intercity transportation innovations (alternatives) that are within the interest and capabilities of panel members.

   a. Vehicles and facilities

   b. Service attributes (geographic coverage, level of service)

   c. Ownership and financing

   d. Other

2. For each identified alternative, describe anticipated positive and negative impacts of system implementation and operation from the standpoint of:

Travelers	Other governmental interests
Operators	Taxpayers
Suppliers	Resource consumption
Labor	Environmental effects
Regulators	Societal effects
Elected officials	Other

Wednesday Afternoon, Session 4

In continuing discussions of each future intercity passenger transportation system alternative, the following topics may be appropriate:

1. Do identified impacts vary depending on future conditions (e.g., background scenario elements)?

2. Are identified impacts affected by uncertainties as to technical performance or costs?

3. What are the prospects for implementation, including:

   - Nature and timing of required actions?
   - Likelihood of financing required capital investment?
   - Institutional and political constraints?

Thursday Morning, Session 5

In the final session, panel recommendations related to completion of the study (and beyond) should be developed.

1. What research and analysis activities might be undertaken regarding potential transportation innovations to:

   - Gain a clearer understanding of the nature and magnitude of impacts?
   - Alleviate identified negative impacts?
   - Enhance positive impacts?

2. Should analyses during the remainder of the project emphasize particular scenarios or transportation alternatives?

3. What other general recommendations do you have for completion of the project?

Guidance on Recommendations to be Developed

To provide additional insights on the nature of possible panel recommendations, the following guidance was developed at the Workshop by the project team and distributed to panel chairmen:

Recommendations Sought.

1. Research on assessing unusual impacts
2. Research on assessing unanticipated impacts
3. Research on uncertainty of impacts

4. R&T on ameliorating impacts

5. Research on technology assessment methodology

6. Research on understanding markets, issues, and trends affecting demand

7. Research on implementation, delivery

8. Research on technology, cost, or performance problems that are particularly critical to resolving impacts or secondary/tertia effects

Recommendations Not Sought.

1. Priorities on hardware, or technology, or modes

2. R&T program

3. R&T plan

4. R&T on problems already recongized and being adequately addressed

5. R&T simply to improve cost or performance

6. Research on agency roles (DOT/NASA/XXX)